THE FOUNDRY

for February

Strange New WORLD

OPERATING any business this spring of 1934, means exploring new paths. The foundry industry is no exception. It represents a strange new world, a brighter one perhaps than at any time within the past four years, but still strangely unfamiliar to castings manufacturers. Improvements in contributing lines of manufacture has raised hope, but foundrymen are confronted by many perplexities. Those firms that have weathered the storm find the problem of actual working capital acute. Circumstances, beyond the control of individual owners and of real menace to firms previously well established and able to command capital for operating their businesses, have swept away resources available as collateral for current loans. The recognized measures of worth have shrunk. Banks, with the fear of the past March *holiday* in mind and the anticipated burden of government financing, under government dictation, ahead shun commercial loans. Cash for payrolls becomes a real problem, while financing of fuel and metals, sand and supplies in the face of similar credit shortage confronting the suppliers of these materials demands financial ability of a new order from foundry managers. What more effective means could be found to shift the employment load to industry, than to ease the credit stringency for machinery and replacement purchasing.

Codes Still PERPLEX

WITH the gray iron code, the last of the four main codes of the foundry industry delayed from final approval by questions of inequalities in wage rates, particularly in the south, tangles in NRA administration procedure are brought out in the light. The pressure for speed in setting up codes introduced many differences which must be adjusted. In the foundry industry, where the same firm may conduct two or more classes of foundry operations in a single plant and sometimes under one roof, the obvious difficulty of paying two or more hourly rates to men who are mingled in their daily tasks becomes evident. Further, the range between closely similar types of employment within certain localities is wide. These conditions produce discontent. They are further complicated by the CWA rates which in some cases more than double the pay provided under accepted codes. Consequently, in some localities the turnover in labor is constant and an actual shortage of men has resulted where foundry operations have improved with the growth of certain lines of activity. This trouble likely will increase with the advance of spring foundry business.

Prices Under FIRE

NO DOUBT the one major benefit which business and industry sought under the National Industrial Recovery Act was the opportunity to escape the ruinous competitive conditions which had brought prices down far below any reasonable range. Early meetings of manufacturers immediately after the enactment of NIRA indicated that attention was focused upon this one asset in the law. Washington understood this pressing need, but has veered with the wind and swung all about the compass from conservative right to ruddy left in its rulings and pronouncements covering code provisions relating to price and costs. From door to door down the corridors of the NRA offices opinions and rulings have varied. In consequence, the vagaries and inconsistencies of many minds are set forth in the codes as established. The open price plan of reporting is in effect under the steel casting code. It has resulted in a volley of attack from users, and attempts to secure radical and ridiculous differential quotations on products thought to be competitive. Buyers have ranged far afield in an effort to find weak points in the line of defence of these new prices, seeking to profit from distress conditions or to induce steel foundries that are in urgent need to break over. Those codes which do not contain price provisions as permitted at one stage, are having difficulty even in establishing uniform costs. A recent ruling of NRA provides

that open hearings must be conducted before even a uniform or standard system of cost accounting may be adopted. Washington, in its wisdom, is going to establish the how and why of cost accounting. It anticipates ruling as to adjusting overhead on the basis of rates of operation, in effect guaranteeing a satisfactory basis to those shops that have shown a high rate of production through good fortune or other reasons. Further, approval of a standard cost system probably will not be forthcoming unless there is full agreement within the industry.

Self Named SAVIORS

IT HAS been hinted that the presence of congress at this stage has changed the complexion of NRA thinking. Perhaps, the anxiety of the typical lawmaker for the welfare of that mythical group, all voters, of course, which always buys and never makes or sells, may have activated the thinking in the department of commerce building. Again, it may be the struggle for self expression on the part of the consumers' representatives, always more or less vocal as one of the advisory agencies without whose approval no code is approved, but not in the spotlight during the summer and fall. Whatever the basic cause, industry is in a fair way of losing any benefit of measures which would lead to fair prices or even adequate protection offered by the more or less emasculated provisions which forbid selling below cost. The zeal for consumer interests takes queer paths as evidenced by another new move. Backed by professorial thinking, a suggestion has been put forward to establish a new standardization agency, designed to put the government in the role of protector of the consumer through the establishment of so-called consumer standards. The work of existing agencies is deprecated as being aligned too closely with the producing rather than the consuming interests.

New Faces APPEAR

PRESSURE has relaxed in pushing through codes, although many remain to be put through the mill. In consequence, many business leaders who gave their time as deputy administrators and assistants during the summer, fall and early winter are beginning to leave the administration offices to return to their own activities or to take over new responsibilities outside the government. All who have had to do with the foundry codes have been warm in their expressions of respect for the work of the NRA personnel to date. Doubtless, those who now take their places in the administration may be of a similar high order of intelligence and earnest intent. But with the changes that eventually take place, what may be expected? Will politics and nepotism enter? Will the price of votes and the clamor of relatives and friends for public pap, people this organization to its ruin? Probably, only the steady and insistent alertness of industrys combined code authorities can prevent. The self administration that has been repeatedly promised to industry should be protected at any cost. This constitutes the best future protection for all American industry and business.

Striking A BALANCE

VIEWING the entire foundry scene under code performance and regulation, the outlook is moderately favorable. Ironing out inequalities in labor costs will be beneficial in the main, although some hardships are thereby introduced in small communities remote from market areas. The prospects for general business promise increased activity, particularly if the key to the log jam holding back railway and heavy equipment business can be found. A premium will be placed upon economical operations, but the rewards will be more sure to owners, managers and workers. A survey of advance in quality and adaptability such as was furnished by the recent engineers' conference in Cleveland, arranged by the American Foundrymen's association, shows the industry better equipped to meet competition from outside the industry than ever before. Those firms that can surmount their immediate problems will survive and prosper.

Time To REBUILD

REGARDLESS of all the pressing problems and worries of the foundry industry today, it is better organized and equipped than ever before. Certain elements of unity have been inculcated and passing without comment all controversial features of the government's program, the benefits of co-operative action have been taught. These can and should be retained. The functioning of organization effort should by no means be confined to business and management problems. Even greater opportunities can be found in furthering joint technical and operating practice, research and improvement, based upon the real progress that has been made. Another important latent asset to the industry can be found in the great army of foundry superintendents and foremen, many still unemployed, who have battled through the depression in the face of severe personal loss and disappointment. These capable men, ready and anxious again to contribute to the advancement of the industry are rarin' to go. Providing them with their opportunity is sound investment.

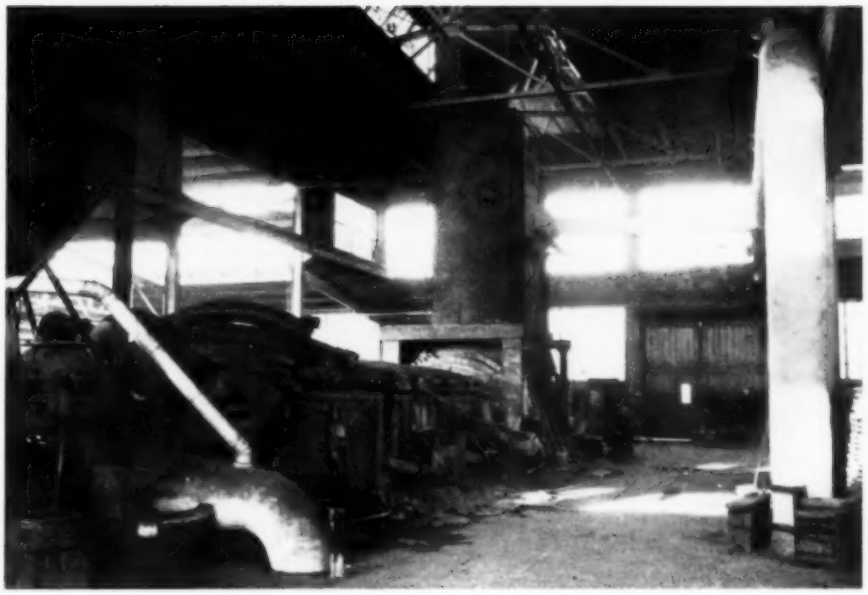


Fig. 1 — The insulated duct from recuperator to fan is arranged to permit operation of the overhead crane

Uses Recuperator on Air Furnace

Installation made on a pulverized coal fired unit with 30-ton melting capacity

A RECUPERATOR installed two years ago on an air furnace at the plant of the Eastern Malleable Iron Co., Naugatuck, Conn., has provided interesting data on the advantages which may be expected through such an application. The furnace on which the installation was made is a pulverized coal fired unit of 30-ton capacity. While normally operated one heat a day weighing 22 to 30 tons, the business situation during the past year has reduced the operating schedule at least a part of the time to smaller heats and not a full week.

As shown in the accompanying illustrations, the recuperator is an independent structure mounted on an elevated platform at the stack end of the furnace. Air for combustion is drawn through the recuperator and connecting duct to the fan at the mill, and is mixed there with the coal fed to the burners. The fan suction is only that necessary to overcome friction loss through the tubes, and therefore the pressure in the two chambers is practically balanced. A by-pass between the main air duct and the pulverizer provides hot air for sweeping the mill and drying the coal. Atmospheric air also is admitted to the pulverizer to dilute the high temperature air from the recuper- (*Please turn to page* 52)

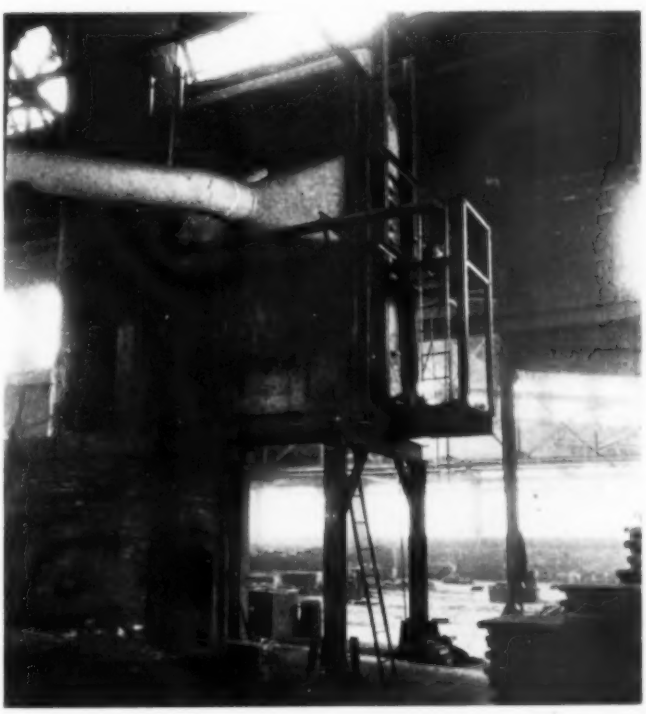


Fig. 2—The recuperator is an independent structure mounted on an elevated platform

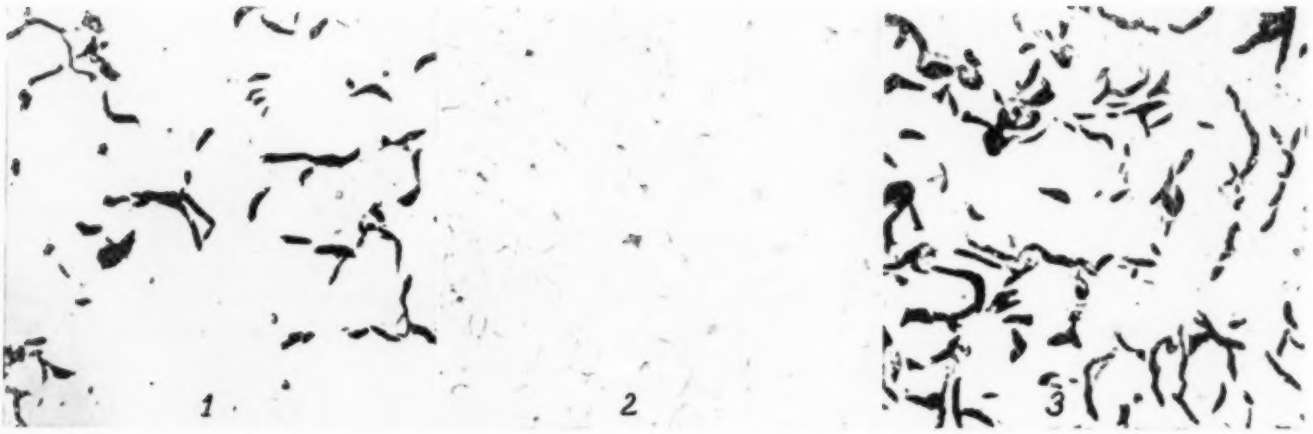


Fig. 1—Cast iron polished on fine broadcloth, X100. Fig. 2—Same sample reground polished and finished on a velvet wheel, X100. Fig. 3—Cast iron polished on broadcloth having a heavy nap, X100

Polishing Cast Iron Specimens

Comparatively little skill required in operation lasting less than a minute

By EUGENE W. NELSON

LACK of criticism when Vilella's work on polishing cast iron to show the true size of the graphite flakes first appeared no doubt, was due to the fact that his polishing method was somewhat difficult and required more time and skill to obtain perfect results than the ordinary industrial metallographer could spare. With the simplification of the procedure metallurgists became interested in the fact that what they had thought to be graphite in cast iron was nothing but the holes where the graphite had been.

These men demanded proof that the slender, gray flakes they now viewed, instead of the large black splotches so familiar to every student of metallography, were the true graphite flakes. They voiced many objections and presented many reasons to prove that the black splotches were the true graphite flakes. Chief objections were that in polishing as Vilella polished, the soft iron was smeared over the graphite "as butter is smeared over a piece of bread" and that when a piece of the *correctly* polished iron was etched and then examined at 100X the particles of graphite appeared large and black because the etchant dissolved the iron

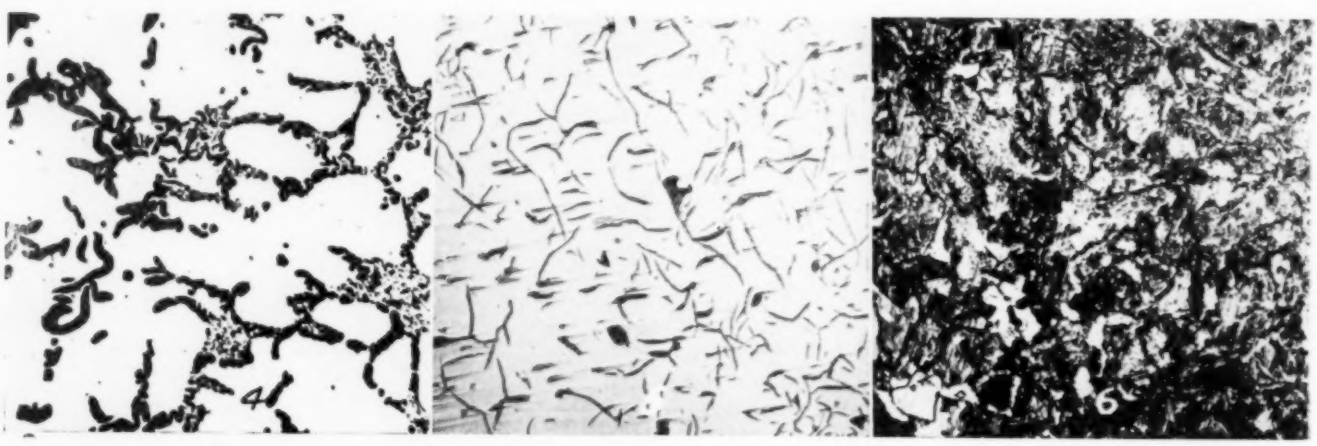


Fig. 4—Cast iron polished on heavy broadcloth for a longer time than in Fig. 3, X100. Fig. 5—Specimen showing the dragging effect of nap, X100. Fig. 6—Showing same condition as Fig. 5 in etched specimen, X100

which had been smeared over the graphite.

For the benefit of those not already familiar with the difference which polishing makes in the appearance of graphite in cast iron, Fig. 1 shows a piece of gray cast iron polished on fine grade broadcloth with alumina as an abrasive. This micrograph is 100X and unetched. Fig. 2 shows the same sample reground and then polished through 0000 paper and finished on a cheap velvet wheel. The nap of the velvet had been completely worn away with a scraper and the cloth impregnated with a little powdered rouge and distilled water. It has been found that this wheel is superior to others for this type of work.

While polishing cast iron on this velvet wheel, a few drops of water are added from time to time and the specimen is moved slowly about its own axis through an angle of 90 degrees. For an ordinary specimen finished on 0000 paper, no

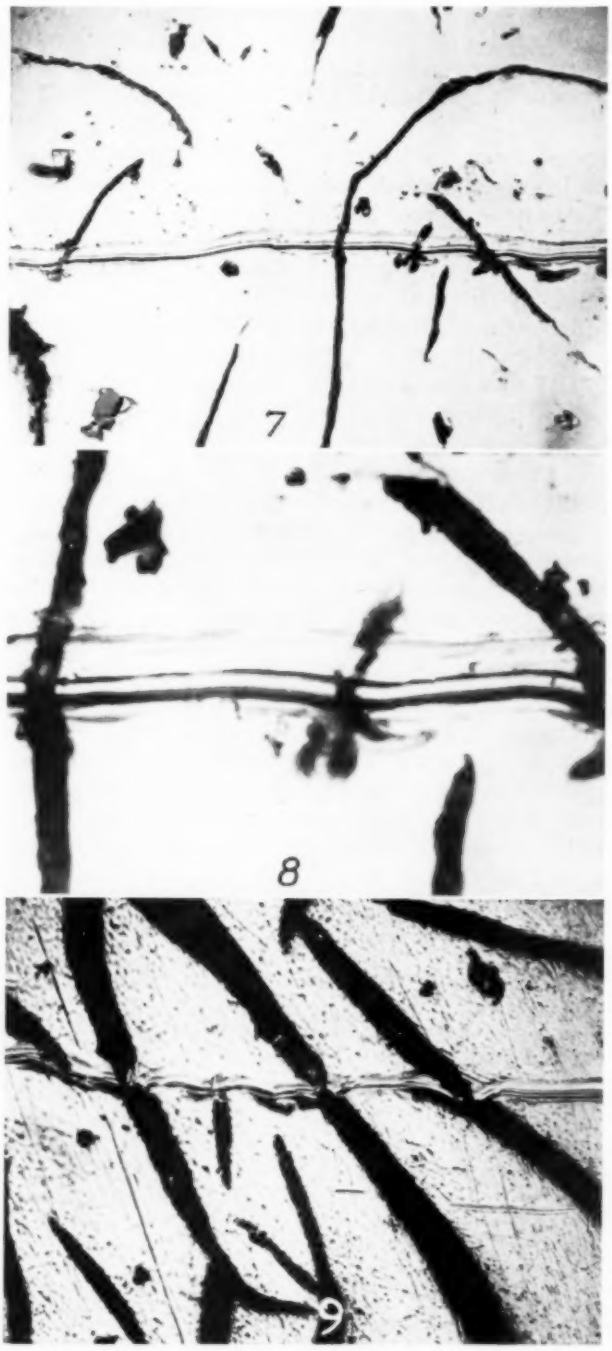
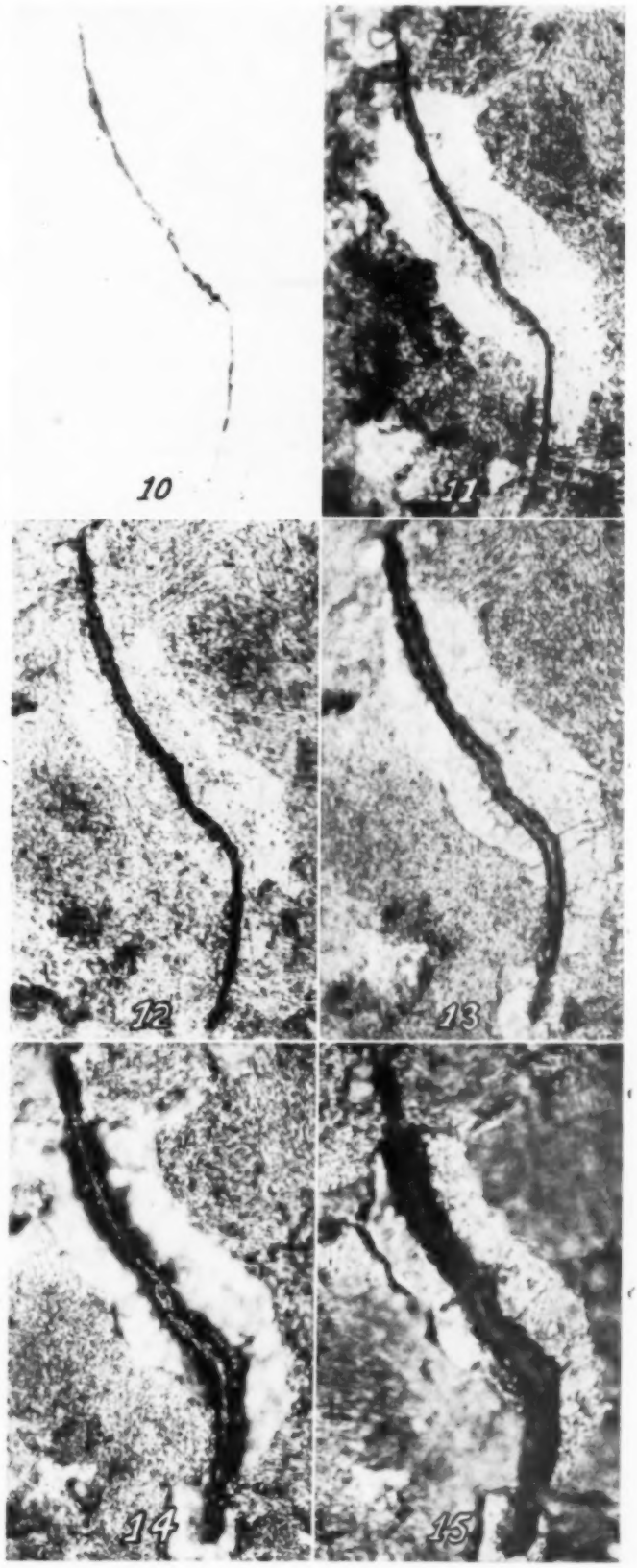


Fig. 7—Scratch cutting graphite, unetched, X500. Fig. 8—Same sample as in Fig. 7, X2000. Fig. 9—Specimen polished on broadcloth showing scratch dragging ferrite into holes



Figs. 10 to 15—Series of tests on sample showing effect of various periods of etching, X500

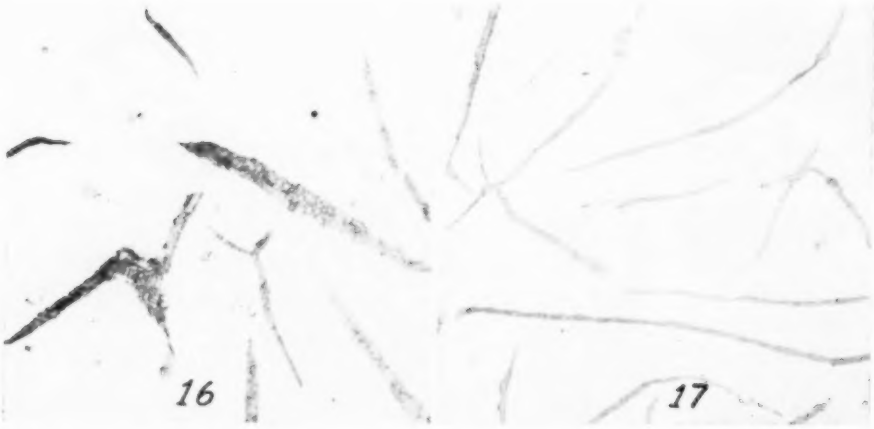


Fig. 16—Specimen showing very coarse graphite, unetched X500. Fig. 17—Iron specimen showing coarse graphite, unetched, X500

more than a minute is necessary on this finishing wheel. Little skill is needed and there is absolutely no danger that the graphite will be dragged out, provided the nap has been removed. A specimen of cast iron has been held on the wheel for a period of 10 minutes without any bad effects being observed.

Some of the effects of poor polishing are shown in the accompanying illustrations. Fig. 3 is the same specimen of iron shown in Figs. 1 and 2 except that instead of having been polished on a fine grade of broadcloth, it was finished on a coarse broadcloth which had a heavy nap. The holes from which the graphite had been dragged are enlarged to a greater degree than they were in Fig. 1. A longer polishing time on this same cloth produced the effect shown in Fig. 4. Here the holes are so enlarged that they occupy nearly half the field.

Dragging, or directional polishing, is to be avoided. This occurs when the nap is not removed entirely from the velvet. The illustration Fig. 5, at 100X, unetched shows the graphite holes slightly enlarged but badly dragged out. Fig. 6 illustrates the same condition, except that here the dragging was so slight it did not show until after the specimen had been etched. Danger is present where the cast iron specimen is polished on a dry broadcloth wheel. The ferrite may be smeared over the graphite. Some men think this condition exists even when the specimen has been polished on the napless velvet cloth.

Two tests were run to clear up this point. In the first, a specimen of cast iron was polished on the new velvet wheel and a scratch made across the surface with the Bierbaum micro-character needle. The appearance of this scratch as it crosses several flakes of graphite is shown in Fig. 7 at 500X and Fig. 8 at 2000X. Conclusive proof is shown in Fig. 8 that no iron is lapped over the graphite. Size of the graphite particles is the same from the tops to the bottoms of the depressions. Fig. 9 shows the appearance of the same specimen polished on heavy broadcloth in the old style. The micro-character scratch on this surface, at 500X shows that the needle actually dropped into the holes where the graphite had been. The soft iron had been dragged down into the depressions which supplies additional proof that no graphite was left in these holes.

A further test was made at the suggestion of a metallurgist who claimed that a specimen of cast iron, polished by the new method, subjected to a prolonged etching in nital and then viewed at 100X would show large black splotches of what must be pure graphite. The acid would dissolve any ferrite smeared over the graphite flakes.

Fig. 10 at 500X shows a single flake of graphite unetched. This specimen was etched for five seconds in a 4 per cent solution of nital and the appearance is shown in Fig. 11. The acid actually etched a hole around the graphite but the graphite itself was not enlarged. The specimen then was etched an additional ten seconds and the appearance of the graphite flake is shown in Fig. 12. The (*Please turn to page* 54)

Fig. 18—Specimen illustrating medium graphite unetched X500. Fig. 19—Fine graphite, unetched X500. Fig. 20—Fine graphite, unetched X500

Copper in Gray Cast Iron

Investigations show changes in properties as a result of adding alloy to the metal

By C. T. EDDY

Michigan College of Mining and Technology, Houghton, Mich.

IMPROVEMENT of properties of cast iron by alloy additions has been a natural outgrowth of attempts to utilize the vast amount of information concerning the effect of various special elements on the properties of steel which has resulted from extensive research on alloy steels. Stimulated by this research, investigation of cast irons was undertaken which has somewhat done away with the former divergence of opinion respecting the effects of added elements.

That divergence was due partly to inconsistencies in foundry technique (including molding, pouring, introduction of alloying element, and temperature control) and also to differences in rates of cooling because of variations in size of sections selected for study. These variables, coupled with the rarity of attempts to heat-treat castings for the purpose of controlling the structure, naturally brought about discrepancies among the data which was secured by different investigators.

Have Developed New Alloys

Not only have such differences of opinion been reduced, but new alloys have been developed. Among these are nickel, chromium, and nickel-chromium irons. A large number of alloy cast irons containing these elements in varying proportions now are used widely.

However, little has been published concerning the use of copper in cast iron. Furthermore, as formerly was the case with the alloy cast irons named previously, there is considerable difference of opinion on the subject. It was with a view to making a systematic and statistical study of the effect of copper on cast iron that an investigation was started at the Michigan College of Mining and Technology, Houghton, Mich., during the early stages of the present research program carried on by the institution. The purpose of the investigation was to review the possibility of using copper to advantage in cast irons.

In general our findings are these: Copper like silicon and nickel decreases the tendency of cast iron to chilling. It assists the decomposition of primary cementite or prevents its formation. This effect of assisting graphitization together with the change of the pearlite to sorbite or a higher form in the matrix and the strengthening of the ferrite because of dissolved copper results in a hard strong iron which because of the absence of free cementite possesses good machinability.

The effect of copper on the hardness and on the strength in compression is marked, and the advantage of improved machinability is retained. Tensile and transverse strengths also are improved materially both by this strengthening of the ferrite and refining of the matrix and in addition by the refining of the graphite precipitate and the uniformity of its distribution.

Gray Iron Has Closer Texture

Copper refines the austenite grains as well as refining the graphite and improving its distribution. The combined effect is that the resulting gray iron has a much closer texture since the pearlitic structure apparently is inherited from the austenitic grains. Fractures of copper-bearing cast iron when compared to other alloy cast irons under investigation support this finding.

The eutectoid point is shifted to the right with the introduction of copper. This is a decided advantage, as it makes it possible to increase the combined carbon in the matrix and still prevent the formation of free cementite. A part of the marked increase in the brinell hardness undoubtedly is due to this condition as well as to the others previously mentioned. In addition to these advantages, high-copper cast iron is resistant to certain forms of corrosion. Much work done in this field by other investigators confirms this added advantage.

In undertaking this study various series of alloys containing copper, nickel, and chromium in different proportions were investigated with a view to establishing the effect of copper alone and in combi- (*Please turn to page* 57)

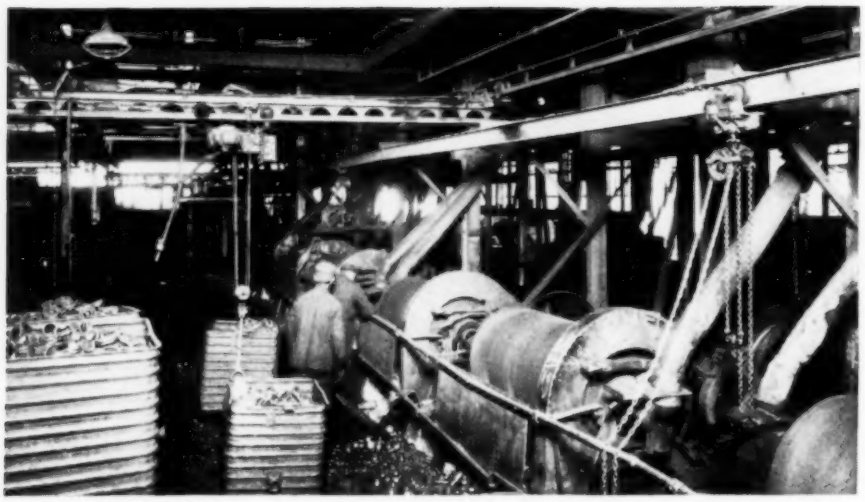


Fig. 7—Tumbling barrels are loaded with cranes and discharged through the floor on to a belt

Specializes in Small Castings

Close control of materials and constant supervision insures quality of castings

By PAT DWYER

SO FAR as may be practicable with the volume of orders, all castings made at the Fostoria, O., plant of the Electric Auto-Lite Co., are divided into three main classes for production in three parallel and adjoining bays in the foundry. To some extent the classification is based either on weight or area, but this does not always obtain since conceivably a small, thick casting might weigh considerably more than a light, thin casting of much greater area.

A high surface finish is essential on all castings and for that reason the character of the sand in each of the bays is selected and controlled carefully to insure the desired results. Variation in the several controllable factors is shown in the accompanying table. It will be noted that the moisture content is held to a minimum in all cases, 4.5 to 5 per cent for the light castings and 5 to 5.5 per cent for the others. This factor must be considered in connection with the bond, 12 to 13 per cent for the light castings sand and 14 per cent for the others. The grain size, 95 to 100 for miscellaneous heavy castings, 112 for brake drums and 125 for light castings bears an important relationship to the surface appearance of these castings. Combination of the various factors is reflected in the

Variation in Sand Characteristics

	Permeability	Green Moisture per cent	Compression pounds	Grain	Bond per cent
Brake drums.....	45	5 –5.5	5	112	14
Light castings....	29–35	4.5–5	4–4.5	125	12–13
Misc. heavy.....	50–55	5 –5.5	5	95–100	14

Fig. 8—All castings are given a final critical inspection before they are taken to the truck loading dock in the rear

permeability, 45 for brake drums, 29 to 35 for light castings and 50 to 55 for miscellaneous heavy castings. The green compression strength, 5 pounds for the sand in two bays and 4 to 4.5 pounds in the bay where the lightest castings are made indicates the firmness and strength of the sand forming the walls of the molds.

An individual sand preparation and sand handling system is maintained for each of the three molding bays in the foundry. The three sand mixing units occupy space at the south end of the bays in line with each other and in line with the partition separating the molding department from the cleaning room.

Sand Is Prepared in Muller

Sand from the shakeout is conveyed by belt and discharged over a magnetic pulley to the boot of an elevator which carries it aloft, and discharges through a screen and revivifier into a tank. From the tank it is fed down to 6-foot diameter muller supplied by the National Engineering Co., Chicago. The muller discharges the sand into another elevator which in turn carries it aloft to a storage tank. A long belt carries the sand from the bottom of the storage tank to the openings above a series of bins arranged in line over the battery of molding machines. Each of the bins or chutes is equipped with a hand controlled gate at the bottom. When the molder opens the gate the sand falls by gravity into the flask mounted on the molding machine. Routine testing of the sand according to methods set up by the American Foundrymen's association is conducted in the laboratory at stated intervals during the day. An experienced operator attends the mixing stations.

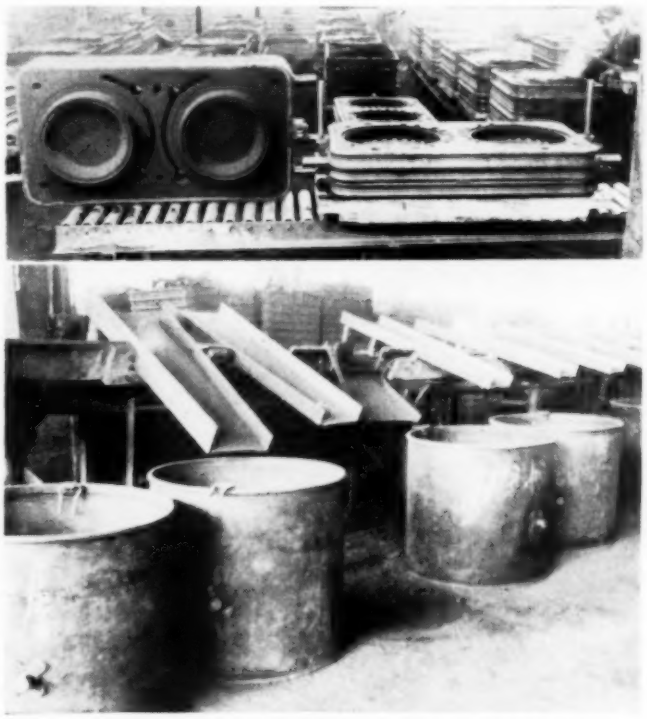


Fig. 9 (Above)—Brake drums with steel inserts are molded two in a flask and poured separately. Fig. 10 (Below)—Chutes above the moving belt guide the various castings into their proper receptacle

Fig. 11—After passing the various chutes, all castings remaining on the belt are discharged over the end

All castings are comparatively light in section and are shaken out almost immediately after they have solidified, therefore none of the sand is burned to any extent and only a small part of the moisture is evaporated. This condition greatly reduces the amount of water, new sand or other bonding agent required to restore the sand to its original state in the mixers. Necessary adjustment in the relationship of the various factors, bond, permeability and grain size, is effected from time to time by the addition of measured quantities of new sand, or a proprietary clay. Instead of facing the molds with a special mixture, coal dust to the extent of approximately 4 per cent is added to the entire sand supply. Thus the sand automatically becomes both facing and backing sand.

Castings Handled on Conveyor

Several forms of conveyor systems are in use for handling the molds, sand and castings. In addition to what may be termed the permanent conveyors, units established and functioning in a definite area, short sections of portable roller conveyors are set up from time to time at various locations as occasion may demand. For example the short section shown in Fig. 9 serves as a temporary resting place for the cope and drag of a brake drum mold, immediately upon removal from the molding machines. After the mold has been inspected and—if necessary—any minor repairs effected, it is placed on one of the many roller conveyors extending from a line near the molding machines, to a long central gangway.

This brake drum made in several sizes, small size two in a flask, large size, one in a flask, presents many interesting features whether regarded from an engineering or purely foundry standpoint. The finished unit is a combination

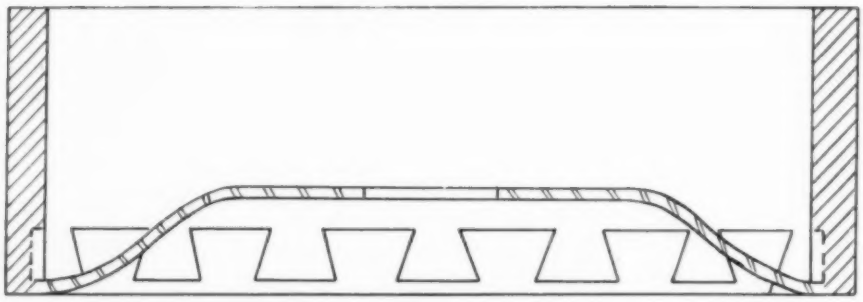


Fig. 12—Sectional view of brake drum illustrating method of locking the steel plate in place

of steel back or center plate, and cast iron band which supplies the traction for the brake when the casting is in use.

One entire bay of the foundry is devoted to the production of these castings. The battery of molding machines is arranged in pairs at the back end of the floors. The finished molds are placed on roller conveyors with a capacity of from 15 to 20 molds. Sequence of pouring the metal is arranged in a manner to prevent congestion on the conveyors. Immediately after the castings have solidified the molds are dumped on a long grating in the floor paralleling the gangway. The sand falls through the grating to a conveyor which carries it to the mixing station. The flasks are returned to the vicinity of the molding machines and the castings are loaded in steel containers and taken to the cleaning room either by truck or suspended from the monorail.

Drag molds are made on jolt machines made by the Osborn Mfg. Co., Cleveland, while the copes are made on combination jolt-squeeze machines supplied by the Milwaukee Foundry Equipment Co., Milwaukee. Projections on the cope bars support the hanging sand ring which may be noted in Fig. 9. Special blocks attached to the squeeze plate on the molding machine enter between the bars and impart the necessary density to the sand in these rings. Despite this extra pressure the permeability of the sand is sufficient to allow escape of all gas and steam without any venting with a wire.

The thin circular steel plate which forms the end of the drum is slightly dished and is provided with a flange about 1-inch in height for connection with the cast iron band. The flange carries a series of 1 x 1-inch notches which lock plate and rim firmly together. The steel plate rests on the bottom of the mold with a clearance of $\frac{1}{4}$-inch between the flange and the vertical face of the mold. General features of the assembly are shown in the sectional view Fig. 12, a free hand illustration and not drawn to scale or to exact contour.

In addition to the mechanical grip afforded by the notched rim and the pressure exerted by the natural contraction of the cast iron rim, a more intimate union is effected by fusing the adjoining parts together. This latter feature is effected by introducing exceedingly hot metal through a great number of small gates at the top of the rim. Each brake-band is poured separately through a single sprue leading to a semicircular runner in the cope as shown in Fig. 9. The runner extends approximately half way around the casting and feeds the 12 small gates formed in the joint surface of the drag. The steel plate is copper plated to facilitate amalgamation and to prevent oxidation and the resulting evils, gas pockets, cold shuts and lack of adhesion. Castings broken for examination show an intimate union between the cast iron band and the steel center plate.

Method and equipment for molding and pouring light castings in the second central bay are similar to those observed in the bay devoted to the production of brake drums. Molds are placed on roller conveyors extending from the battery of molding machines to the main gangway. A slightly different technique is followed in shaking out the castings. A concrete chute shown in Fig. 11 extends in front of all the conveyor units and terminates at a point close to the sand preparation plant.

Molds and contents are dumped in this chute in which the bottom is a plate conveyor. The snap flask bands are retrieved and returned to the molding stations. Sand and castings travel to the end of the chute where the sand is discharged on a cross belt feeding the mixer and the castings continue up an incline, over a vibrating screen and into containers in the cleaning room.

In the third or western bay the molding machines occupy a position (*Please turn to Page* 58)

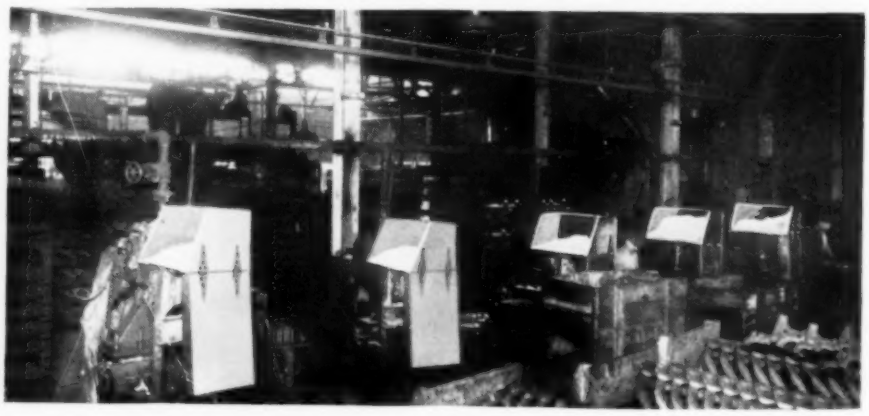


Fig. 13—A wide variety of small cores is produced on a battery of machines on which the sand is blown into the coreboxes under pressure

Galvanizing Malleable Castings

Metal should be at proper temperature before starting the dipping operation

By GRAFTON M. THRASHER

CASTINGS prepared as described in the first article presented in the January, 1934 issue of THE FOUNDRY are ready for the hot dip in molten zinc. As by far the largest proportion of fittings is galvanized by the basket method, that procedure will be described in detail.

Before starting to galvanize, metal should be at the proper temperature which in this case should be about 870 degrees Fahr. plus or minus 10 degrees, and a flux must be prepared upon its surface. In making the flux for the basket method thickeners like bran, etc, are not used and a thin flux is prepared by throwing several shovels of salammoniac or of the double chloride of zinc and ammonium, onto the molten metal. This will spread out in a thin froth-like covering which absorbs the oxide films, converting the zinc oxide into chloride at the expense of the salammoniac. Since considerable salammoniac is lost when making up a new flux from salammoniac alone, some prefer to use the double chloride of zinc and ammonium. This costs considerably more but requires less salt and avoids a heavy smoke of salammoniac fumes which in poorly ventilated shops, would be objectionable.

Place Castings in Baskets

Baskets used are cylindrical with a flat flanged-in and riveted bottom of sheet steel with $\frac{5}{8}$ or $\frac{3}{4}$-inch holes punched in both the sides and bottom to allow free circulation and drainage of the molten zinc. A diameter of 10 inches and depth of 9 inches is found convenient. This is fitted with a straight "stew pan" handle of 1-inch pipe 6 feet long and terminating with a loop of $\frac{5}{8}$-inch round iron for gripping.

From four to six of these are heated on the edge of the kettle before loading to be sure they are dry so they will not explode when put into the kettle of zinc. When the baskets are well heated, castings are shoveled into the baskets from the shelf of the drying table. About 25 pounds per basket is all that can be handled conveniently considering the additional weight of the basket and the labor involved in shaking. The basket should not be more than half full to permit jouncing without throwing out some castings.

The baskets are lowered into the zinc through the covering of flux. At this stage the thin coating of iron chloride ($FeCl_2$) which was dried on the castings will rise from the zinc and be absorbed by the flux which seems to improve its fluidity.

Iron Content Is Constant

Several analyses of the flux taken on different days in the same week gave the ferrous chloride ($FeCl_2$) content as 1.36, 1.72, 1.86 and 1.27 per cent. A higher content is not often obtained as at the temperature of the kettle the chloride continually is being volatilized with some ammonium chloride and at the same time is being replenished by more iron chloride from the film on the castings and more salammoniac (ammonium chloride) from the sifter used over the basket when shaking. If these chlorides are not replenished constantly their volatilization causes the flux gradually to be converted into zinc chloride ($ZnCl_2$) making it dry and ineffective as a covering as it lacks fluidity.

When the baskets have been immersed in the zinc for about 3 minutes the handle of the first basket at the operating end of the kettle is maneuvered to a stationary fulcrum piece resting on the top of the kettle setting about 10 inches from the edge of the kettle.

By pushing down the end of the handle, the basket is raised quickly, draining most of the zinc from the castings. The castings then are jounced or shaken by quick upward jerks at the end of the handle with the right hand, at the same time holding the handle down at the middle with the left to prevent it from jumping off the fulcrum fixture. The motion causes the castings momentarily to leave the bottom of the basket and be suspended in the air. They revolve toward the operator, hitting the bottom of the basket with each movement with sufficient force to throw off surplus zinc. Shaking is continued

for 25 or 30 seconds and a shower of salammoniac is delivered into the basket, either by another operator or by some mechanical device. This salammoniac causes the spots of sticky flux and oxide to run off freely from the surface of the castings and evens up the coating.

When the shaking has been completed the basket is tipped quickly to deliver its contents into a tank of water located at the end of the zinc kettle. This bath sets or freezes the coat-coating quickly and in such a manner as to prevent the individual castings from sticking together. Water tank is kept covered with a layer of oil and the castings should be removed almost instantly so they will dry quickly from retained heat otherwise the coat will have a dull appearance from the action of the water.

Remove Castings Mechanically

After the baskets are heated by the first round through the kettle the time of immersion is shortened to about 1½ to 2 minutes. To remove the castings from the water rapidly, it is best to use some mechanical device such as an inclined apron conveyor. The water tank is provided with an overflow pipe extending to within a few inches from the bottom by which the sludge, formed from some flux on the casting, constantly is being removed without much loss of oil. A constant stream of water running into the tank prevents too high a temperature and consequent trouble from castings sticking together.

Fluidity of the zinc, and therefore its ability to form an even coat, is improved considerably by a small addition of aluminum but great care must be taken to prevent the addition of too much as it rapidly will destroy the flux coat on the molten zinc. Aluminum is best added in the form of an alloy cast into small bars (solder molds) and the composition would be 10 per cent aluminum with 90 per cent zinc. This is sold by alloy dealers and is sometimes called *silver metal*. A maximum practicable percentage of aluminum in the zinc bath when galvanizing by this process seems to be about 0.25 per cent.

Aluminum reduces zinc and iron oxides in the molten metal throwing the iron out of solution and causing more rapid settling of the dross formed in galvanizing. It also whitens the zinc coat on the castings and, through finer crystalization while cooling, the flexibility of the coating is improved making the coating less likely to separate from the casting when abused by bending, etc.

When introducing a basket load of castings into the molten zinc care should be exercised to prevent any castings from floating from the basket. Castings like 90 degrees elbows and pipe caps, which trap air when introduced with open ends down are especially likely to float. This condition is aggravated by having burned the flux coat in drying or by insufficient pickling action on the interior.

The floaters are sometimes hard to detect and may be overlooked as the castings will float just below the surface and may be covered by a thin coat of zinc or flux showing only by a slight hump where they are. These floaters will sink after a few minutes and going to the bottom of the pot are constantly acted upon, rapidly turning into a mass of dross.

Interior Filled with Dross

A malleable pipe fitting (2 inch tee) which was suspended on a wire about 6 inches below the surface of the zinc in a galvanizing kettle for 3 days had an interior entirely filled with dross while most of the dross formed on the outside washed off into the kettle. In a similar test started early on Monday morning and removed right after noon on Friday only the three beads of the tee remained on the wire, the balance of the fitting having been entirely converted into dross which went to the bottom of the kettle. From this it may be seen how important it is to guard against this loss, as for every pound of castings so lost in the kettle there is formed about 25 pounds of dross. Even if a casting is left in the zinc for an hour or so it becomes unfit to use and is therefore scrapped.

To illustrate the costliness of neglecting precautionary measures at this point let us assume the cost of a 1-pound casting up to the time it goes into the kettle at $0.05, the zinc at $.05 per pound and the dross at $0.03 per pound. (Zinc and dross are both lower at present but the differential of $0.02 between them is not at all unusual).

Loss on 1 pound casting at 5 cents....	$0.05
Loss on 24 pounds zinc at 5 cents.....	1.20
	$1.25
Credit on 25 pounds dross at 3 cents..	.75
Loss on each pound of castings	$0.50

Instances are on record where in breaking in green help the dross production has been increased to three or four times the normal amount due to the floaters and to those castings which may be jounced from the baskets when shaking.

To those who have (*Please turn to page* 60)

Results of Measurements on Various Specimens

No.	Kind of Metal	Thickness Before Inches	Thickness After 72 hrs. Inches	Thickness Lost Inches	Ratio Steel=1
1	White Iron	0.25	0.124	0.108	5.4
2	Malleable	0.25	0.000	0.25	12.5
3	Steel	0.25	0.230	0.02	1.0
4	Malleable	0.25	0.000	0.25	12.5
5	Gray Iron	0.25	0.109	0.141	7.0

Fig. 1 — Assortment of brass die casting produced on a cold-pressure chamber machine which uses comparatively high pressures and makes it possible to cast nonferrous alloys at relatively low temperatures. Some of the castings shown were made available through the courtesy of Walter P. Sherman

Recent Die Casting Developments

Include new alloys, machines and die steel for the production of aluminum die castings

By SAM TOUR and F. J. TOBIAS

Lucius Pitkin Inc., New York

DIE CASTING as practiced in the United States can be defined as the art of forcing into a die molten or plastic material under sufficient pressure to fill the cavity in the die completely. Recent noteworthy developments in the industry have been along three separate and distinct lines—new zinc-base alloys, a new type of casting machine, and a new die steel for use in the production of aluminum die castings.

Introduction by the New Jersey Zinc Co., New York, of new zinc-base alloys with superior physical properties, high impact strengths and negligible dimensional changes has opened new fields for the industry.

Many assembled products containing die-cast parts and articles made entirely of die castings have appeared on the market recently. In spite of the depression, these products were sold in fairly large quantities as the result of their comparatively low cost and high physical properties, combined with a well-organized effort to apply taste to the design and finish of the product.

A few of the articles which might be mentioned are a screw cutting lathe with 43 zinc base die cast parts such as gears, gear housings, gear carriers, pulleys, hand-wheels, and the like; a can opener with nickel-plated zinc-base die cast levers, crank and gears; a kitchen stove, especially designed with more than ten die cast parts; auto heaters; washing machines; and many others.

The use of zinc for zinc-base alloys increased from approximately 30,000 tons in 1932 to 50,000 tons in 1933. The consumption of zinc for this purpose in 1928 was 28,000 tons and in 1929 was 36,000 tons.

The better physical properties of the die casting alloys and the use of somewhat higher pres-

Table I

Properties of Copper Alloys Cold Pressure Cast

	Average Tensile Strength, pounds per square inch	Elongation, Per Cent	Brinell Hardness*
85% Cu., 6% Zn., 9% Sn	39,000	1.6	80
86% Cu., 14% Sn	39,000	0.4	96
(x) Manganese Bronzes with 1.4% and 3% Mn	64,000	20.0	115
(x) Tombasil—13.5% Zn., 82% Cu., 4.5% Si	86,000	30.0	140
(x) Delta Alloy—41.61% Zn., 55.94% Cu., 0.72% Pb., 0.81% Mn., 0.87% Fe., 0.34% P	75,000	25.0	150

*Brinell hardness was determined with a 10 millimeter ball, 500 kilogram load for 30 seconds.

Note: (x) before the alloy indicates that the test bars were machined before test and, therefore, figures are somewhat low compared with test bars where the chilled skin has not been removed.

sures have made it possible to reduce wall thicknesses and save material. The thinnest cast wall at present in zinc-base die castings is on a spark plug shield—0.0155 inch. In clock cases, automobile horns, and similar castings, a wall thickness of 0.034 inch is not unusual.

Table II compares Zamak No. 2 (4.0 per cent aluminum, 3.0 per cent copper, 0.05 per cent magnesium, balance high grade zinc) with Zamak, No. 3 (4.0 per cent aluminum, 0.05 per cent magnesium, balance high-grade zinc). Zamak No. 2, represents the best alloy of the older type, while Zamak No. 3, in the opinion of the authors, is one of the best and most desirable of the new types of alloys.

A new type of die casting machine, developed by Joseph Polak, Prague, Czechoslovakia, using pressures from 4000 to 15,000 pounds per square inch, compared with pressures of 150 to 1500 pounds per square inch in previous machines, makes it possible to cast nonferrous metals and alloys at much lower casting temperatures. In the case of 60-40 brass, for example, casting temperature of the metal is as low as 1575 degrees Fahr.

In the *Iron Age*, Nov. 30, 1933, William W. Seig, metallurgist, Titan Metal Mfg. Co., Bellefonte, Pa., discussed brass pressure castings. This article was of considerable significance for it presented data resulting from practical experience over an 18 months period of actual production in the United States. Three of these high-pressure machines are in use in the Titan plant.

The term "pressure castings" has been adopted by some to distinguish castings made on these new high-pressure type machines from "die castings" as produced on the older types of machines.

In the older types of machines, the metal usually is melted in an iron pot equipped with a submerging cylinder and plunger or a gooseneck as integral parts of the machine. Dr. L. Frommer, in his *Handbook of the Die Casting Technique*, published in Berlin in 1933 by Julius Springer, very logically applies the name "machine with a hot-pressure chamber" to these older machines to explain their basic difference with the newer machines with a "cold-pressure chamber." In the new high-pressure machine, the metal pot is separate from the actual machine and the molten material to be cast is transferred before every shot by means of a hand ladle into a cold cylinder which is a part of the machine proper.

Machines of the cold-pressure chamber type are economical for the production of castings from many nonferrous metals. To date these machines have been used largly for producing brass castings. The following data taken from the article by Seig are indicative of the experience of 1½ years of actual production in this country:

Weight of castings, pounds	Up to 11
Approximate shots per hour	126
Hydraulic pressure, pounds per square inch	3000-6000
Casting temperature of brass, degrees Fahr.	1575
Usual alloy composition, per cent	Cu. 60.0; Zn 38.75; Pb. 0.75; Sn. 0.50
Greatest die life experienced, shots (Special die steel used)	121,000

Seig also gives data on an alloy called "Tinicosil" containing 16 per cent nickel with a tensile strength of 90,000 pounds per square inch, and data on test bars of zinc-base alloy Zamak No. 2 (4 per cent aluminum, 3 per cent copper, 0.05 per cent magnesium, with an average tensile strength of 58,400 pounds per square inch and 6.2 per cent elongation in 2 inches. Impact strength is not given by Seig but on this alloy should be between 10 and 15 foot-pounds.

Seig gives no data on Zamak No. 3 (4 per cent aluminum, 0.05 per cent magnesium) alloy as produced on a "cold-pressure chamber" type of machine. One of the authors has found a tensile strength of 40,-

Table II

Comparison of Zinc-Base Die Casting Alloys

Data from New Jersey Zinc Co. and Tests Made by Authors

	As Cast	Steam Test 95 Deg. Cent. 5 Days	10 Days	Annealed at 95 Deg. Cent. 6 Months	1 Year	2 Years	Indoor Aging 1 Year	2 Years	3 Years
AVERAGE TENSILE STRENGTH IN POUNDS PER SQUARE INCH									
Zamak 2	47,000	46,000	45,000	40,000	39,000	38,500	48,000	48,500	49,000
Zamak 3	37,000	35,000	33,000	32,000	31,000	30,000	35,000	35,000	35,000
AVERAGE IMPACT STRENGTH IN FOOT-POUNDS									
Zamak 2	15.0	4.0	1.5	1.25	1.25	1.25	12.75	9.75	6.0
Zamak 3	20.0	20.0	19.0	18.50	21.00	16.50	20.25	19.00	19.75
AVERAGE ELONGATION IN PER CENT IN 2 INCHES									
Zamak 2	8.4	1.6	1.0	1.3	1.2	1.1	6.7	7.5	5.4
Zamak 3	5.3	5.1	4.0	9.0	8.0	7.0	8.0	7.5	5.4
AVERAGE EXPANSION OF 6-INCH IMPACT BARS IN INCHES									
Zamak 2	— —	+0.0073	+0.0118	+0.0210	+0.0212	+0.0214	—0.0003	+0.0006	+0.0022
Zamak 3	— —	+0.0031	+0.0045	+0.0015	+0.0010	+0.0012	—0.0004	—0.0004	—0.0006

000 to 45,000 pounds per square inch, average elongation in 2 inches of 6 per cent and impact strengths of 15 to 25 foot-pounds.

The physical properties of a zinc-base alloy containing over 20 per cent aluminum and some copper and magnesium, balance high grade zinc, may be of interest from the standpoint of greater lightness:

Average tensile strength, pounds per square inch	45,000
Approximate elongation in 2 inches, per cent	1.0
Approximate impact strength, foot-pounds	6.0
Expansion per inch after 10 days in water vapor of 95 degrees Cent., inches	0.001

In Europe, copper alloys of the compositions and properties shown in Table I are being cast in machines of the "cold-pressure chamber" type. (See W. Brunnckow "Stand und Erfolge des Pressgussverfahrens" Z. F. Met. Kunde 25, No. 8, Aug. 1933, pages 190-194).

Silver 800/1000th fine can also be cast on this type of machine.

Iron Causes Difficulties

In casting aluminum alloys in the ordinary type of die casting machine, the iron picked up from pot, gooseneck and nozzle always is a troublemaker. Iron over a certain amount, depending largely on the alloy composition, affects the physical properties, increases hardness, and makes machining of the casting more difficult. Corrosion resistance and response to anodic oxidation and coloring treatments are also very much influenced by iron content.

Dr. Frommer states that increasing the iron content from 1.1 per cent to 2 per cent in Silumin (Alpax), an aluminum alloy containing approximately 11-13 per cent silicon, reduces the impact strength 68 per cent. The solvent action of the molten aluminum alloy on gooseneck and pots makes frequent replacing of these parts necessary and so increases the maintenance costs of the machine.

Sponginess or porosity in ordinary aluminum die castings is very materially affected by casting temperatures. Excessive temperatures result in increased sponginess. The use of a cold-pressure chamber casting machine with the available higher pressure for casting makes possible the production of die castings at lower temperatures. These lower temperatures combined with the much higher pressures result in increased density, improved physical properties and corrosion resistance of the product.

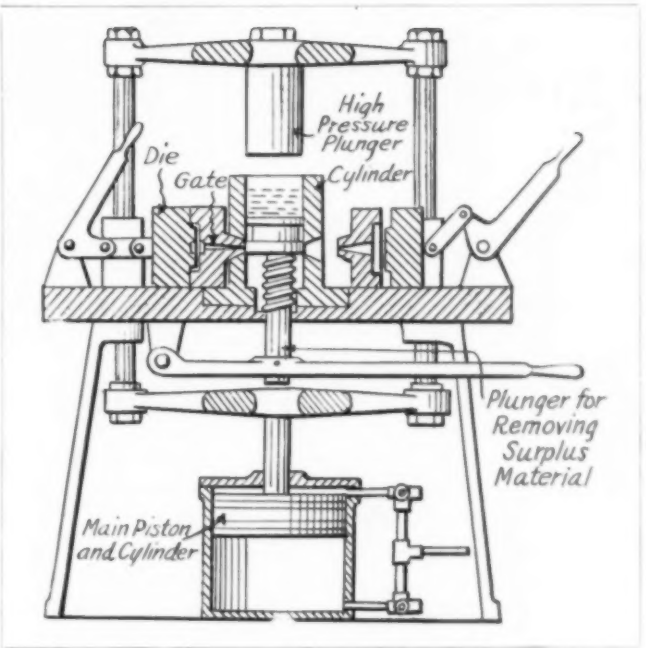


Fig. 2—Schematic diagram of a cold pressure chamber die casting machine. Operating pressures in this type of machine range between 4000 and 15,000 pounds per square inch

Frommer gives interesting figures on aluminum-silicon alloys as cast in a cold-pressure chamber machine. The ordinary 13 per cent silicon-aluminum alloy does not have age-hardening properties but the addition to it of 0.5 per cent manganese and 0.3 per cent magnesium seems to give it such properties. This alloy when die cast is chilled in the die so rapidly that it may be considered to be in the "as quenched" conditions. Reheating (*Please turn to page* 62)

Table III

Physical Properties of Silicon-Aluminum Alloys

Data as Given by Dr. L. Frommer

Alloy	Composition in Per Cent: Silicon	Manganese	Magnesium	Iron	Aluminum	Tensile Strength, Pounds per Square Inch	Elongation, Per Cent	Impact, Foot-Pounds	Machine Type	Brinell Hardness
*Silumin A	12.0	....	....	1.5	Remainder	32,000	0.8	2.00	Hot Pressure Chamber (Gooseneck)	93.5
*Silumin B	12.0	....	....	2.0	"	29,000	0.6	0.82	" " "	83.3
*Silumin C	12.0	0.6	....	0.8-1.8	"	.....	...	2.33	" " "	....
*Silumin D	12.0	0.6	....	2.1	"	.....	...	1.60	" " "	....
*Silumin E	13.0	....	....	1.35	"	36,000	...	1.80	" " "	....
*Silumin F	13.0	....	....	1.9	"	28,000	...	0.78	" " "	....
*Silumin G	10.0	....	....	1.3	"	30,000	1.6	....	" " "	....
*Silumin H	10.0	0.7	....	1.0-1.5	"	33,000	1.7	....	" " "	....
Silumin E	13.0	....	....	....	"	40,000	3.5	....	Cold Pressure Chamber (Polak Machine)	86.4
Silumin Beta	13.0	0.5	0.3	....	"	41,500	1.7	....	" " "	72-88
**Silumin Gamma	13.0	0.5	0.3	....	"	46,000	1.2	....	" " "	122

*Silumin A to H represents different heats of alloys.
**Silumin Gamma represents Silumin Beta test bars annealed at 302 degrees Fahr. for 20 hours.
Impact tests made on unnotched test bar sections of 0.0985 x 0.3152 inch (2.5x8 millimeters).

Questions and Answers

Covering important problems found in all phases of modern foundry practice

This department includes problems relating to metallurgical, melting and molding practice encountered in making castings. Questions addressed to the Editor of The Foundry will be answered by members of the editorial staff, supplemented where occasion requires by the following advisory staff: Steel, John Howe Hall; Malleable, H. A. Schwartz; Gray Iron, John W. Bolton; Nonferrous, N. K. B. Patch

Offer Factors as Guide In Operating 48-Inch Cupola

We are using 2000-pound iron charges in our 48-inch internal diameter cupolas. How does this compare with American practice? We also shall appreciate information on other related features. For example what is the current American practice in weight of coke and limestone, blast pressure and volume.

As with many other features in gray iron foundry operation, no definite set of figures can be set down as representing arbitrary American practice in regard to coke and iron ratio, amount of limestone, blast pressure and volume on a 48-inch cupola. Variables which must be taken into consideration include: Carbon content and structure of the coke; lime content of the limestone; size of the pig iron and scrap; duration of the heat; size and arrangement of the tuyeres.

However, the following factors may be regarded as typical and basic and usually serve as a guide for the foundryman in adopting a procedure to meet his individual requirements: A cupola should melt 10 pounds of iron per square inch of area at the melting zone. One pound of coke should melt 10 pounds of iron. For efficient operation 30,000 cubic feet of air are required to melt 1 ton of iron. A blast pressure of 10 to 12 ounces is most suitable for a 48-inch cupola. The limestone for each charge weighs 40 per cent of the weight of the coke. Thus for a 48-inch cupola the iron charge will be 2000 pounds, the coke charge 200 pounds, the limestone 80 pounds, the melting rate will be 9 tons (18,000 pounds) per hour, the blast volume 4500 cubic feet per minute, the pressure 12 ounces. For a thorough understanding of the subject in theory and practice we recommend "Melting Iron in the Cupola," by J. E. Hurst.

Design Results in Castings Leaking at Junction of Sections

We are forwarding a chronometer valve which we have poured from various alloys, including the standard valve alloy of copper 86 per cent, tin 7 per cent, zinc 4 per cent and lead 3 per cent. We have also used various modifications of the red brass alloy 85 per cent copper, 5 per cent tin, 5 per cent zinc and 5 per cent lead. We have poured the metal at different temperatures all with indifferent success. Approximately 80 per cent of these valves leak under pressure around the bosses. The bosses are all cast solid with a riser on the center boss. The sprue and riser are both about 6 inches in height. We would appreciate very much any suggestion you may have to offer.

The trouble with the castings is lack of feed at the junction of the thick and thin section where leakage is exhibited. This is typical of such trouble arising from such junctions and frequently is a cause for argument with designing engineers. If designers understood the problems arising from such marked change of section without proper fillets, many problems facing the foundry industry would be eliminated. If the designer of the valve would use an ample fillet all around the junction of the bosses with the body, much of the trouble might be eliminated.

Apparently you have no trouble with the central boss because you have a riser in position over that boss to supply the proper feed of molten metal during solidification. If you can provide the same type of feed for the other four bosses, the trouble should disappear.

One method of doing this might be the use of a core for the cope half of the mold instead of the green sand cope. Provide in that core a substantial riser for each of the five bosses. It might help matters materially if instead of gating at the parting of the mold, the gates were to enter the mold at several points at the bottom of the casting. This could be provided for by the

use of a horn gate or a horn gate core. It is surprising that there is no leakage uncovered where the thick hexagonal bosses are attached to the body of this valve; but this is probably explained by the fact that these bosses are so heavy that they serve to feed the junction joint that would ordinarily be porous enough to allow leakage.

If you are able to provide feeders for each of the heavy points on this casting, it then becomes only necessary to pour the casting at the proper temperature to materially reduce your defects. If a fillet is added at the point where these heavy sections join the light sections, a further reduction in the number of defects should be expected. The metal is evidently sound and clean and, therefore, the question of the alloy used is immaterial, with the exception that increased shrinkage and consequent need for feeding is more or less proportional to the increase in the tin content. This is explained by the fact that the copper-tin alloy as it crystallizes out forms microscopical porosity that must be compensated for by proper feeding.

We have known of such conditions being corrected by annealing the castings at about 600 degrees Fahr. for from 6 to 10 hours, after which they were allowed to cool slowly. This would add a further step in the process of manufacture that might raise the cost to a point that would be out of proportion to the sales price. The simplest method is to provide proper feeders for the heavy points that require feeding.

Several Solutions Available For Pickling Gray Iron Castings

Will you give us the proper formula for pickling gray iron castings for hot-dip galvanizing? Our castings will average from 3 to 10 pounds each.

You do not state whether you want a pickle for use just previous to galvanizing, or one which will remove the sand from the castings. Usually the castings are pickled just previous to galvanizing with a mixture of half muriatic (hydrochloric) acid and water, and then are dried without rinsing. As soon as they are dried they are galvanized. If any considerable time is allowed to elapse between drying and galvanizing, there is a tendency of the casting to rust. The muriatic acid pickle aids in producing a good coating of zinc on the casting.

If you are interested in removing sand by pickling, it is suggested that you use a solution composed of 6 gallons of 30 per cent hydrofluoric (not hydrochloric) acid, 4 gallons of muriatic acid, and 40 gallons of water which is used warm but not hot. It will take from 8 to 24 hours to remove the sand, and the solution will have little effect on the castings. After pickling the castings should be rinsed in cold and then in hot water. Sometimes a weak alkali bath is used between rinsings to insure removal of the acid. However, we believe that if you possess pressure-blasting equipment, there will be no need to pickle the castings. Pressure blasting, properly conducted will result in a clean surface on the castings.

Metallic Packing Alloys Usually Are High in Lead Content

We would appreciate details of mixtures for metallic packings using a brass or lead base

As far as we know the alloys which are designated as metallic packing usually are high in lead with additions of antimony and tin. Production of that material is a specialty operation, and the various manufacturers engaged in its production have their own preferred compositions which they have found by experience to be suited best for certain applications. For example in four different mixtures or compositions the lead content varies from 70 to 82 per cent; the tin from 4.75 to 17 per cent, and the antimony from 10 to 17 per cent.

Some compositions are: 70 per cent lead, 13 per cent antimony, and 17 per cent tin; 68 per cent lead, 17 per cent antimony, and 15 per cent tin; 82.25 per cent lead, 13 per cent antimony, and 4.75 per cent tin; 76 per cent lead, 10 per cent antimony, and 14 per cent tin; and

73 per cent lead, 15 per cent antimony, and 12 per cent tin. Composition of a German metallic packing is given as 64.30 per cent lead, 0.50 per cent antimony, 0.15 per cent copper, and 53.30 per cent tin.

Lining Burns Too Fast in 36-Inch Cupola

We are puzzled by the behavior of a 36-inch cupola in which the lining blocks burn away in eight or ten 3-ton heats of approximately 45 minutes duration each.

Running on 3.ton heats a little daubing of mud each morning should keep a 36-inch cupola in good shape indefinitely. You may be using excessive quantities of limestone or other fluxing material when actually none is required on a heat made up presumably of six 1000-pound charges. You may be leaving the blast on too long. In a practically empty cupola at the end of the heat the blast will burn away more lining in a few minutes than it will in a couple of hours when the cupola is filled to the doors.

It may be worth your while to try the bosh form of lining next time you reline the cupola. Proponents claim that the boshed lining does not burn away as rapidly as in a straight lined cupola. Practically all cupolas running on long heats have the boshed shape lining with a shelf overhanging the tuyeres.

Metal Absorbs Gases During Melting

We would like your advice concerning a sample of metal from a bushing which we are mailing. This metal is in a badly oxidized condition. We are using part ingot metal consisting of 80 per cent copper, 7 per cent tin, 10 per cent lead and 3 per cent zinc, using 1/3 of this to 2/3 of borings from our machine shop. The borings are of the same analysis and have first been made into briquets. We make a charge of 400 pounds, melt in an electric furnace, and use 6 ounces of phosphorus to the charge, which is put in at the beginning of the heat. Molds are made of coarse molding sand, are painted with a good grade of plumbago and molasses and thoroughly dried. They are gated at the bottom, raising the gate about 10 inches above the cope. We use no riser. We make smaller bushings of this same metal, poured flat, with which we have no trouble, except for a few fine pin holes, which is of no great consequence.

Fracture of your casting indicates absorption of unburnt gases. Addition of an oxidizing reagent, such as barium sulphate has been recommended as a corrective for this condition. Others have found it advisable to inject air into the furnace to supply the necessary oxygen to burn completely the gases developed; it being recognized that completely burned gases are not soluble.

Another method of correcting this difficulty has been that of leaving the door off of the electric furnace so that the air could circulate in and out of the furnace. In such a method the increased oxygen content increases the amount of electrodes consumed; but in view of the beneficial effect to the metal melted, this additional cost for electrodes is considered advisable.

Whereas many, upon seeing a fracture similar to yours, would call it oxidation of the alloy, it is in reality quite the reverse. It is the lack of oxidation of the gases in the furnace which results in the absorption by the metal of gases, which upon solidification of the metal are thrown out of solution and cause unsatisfactory structure of the alloy.

In several electric furnaces installations it has been found desirable to provide a hose connection with the compressed air line and allow a small amount of this air to trickle into the furnace continuously during the melting, thus providing the necessary oxygen to insure complete combustion of all the gases within the furnace. Where the metal is melted in crucibles in other types of furnace, this gasing of the metal is frequent, due to the lack of supply of the necessary oxygen to complete combustion.

The metal that has been gassed or has absorbed such gases can be recovered rapidly by pouring it into ingot molds and again melting it in a furnace in which a minimum amount of soluble gases are present. This is due to the fact that the gases which have been absorbed are released upon solidification of the metal and, therefore, the metal is in satisfactory shape to be remelted in a furnace in which they are not again subject to similar gases.

Addition of the phosphor copper at the beginning of the melt is not the most desirable time to make such an addition. It would be more helpful to the quality of the metal to add part of the phosphor copper at the beginning of the melt and the balance just before pouring. However, the important consideration, is to avoid the gas absorption and this can only be done by making the gases insoluble through burning them completely by having a sufficient amount of oxygen present.

It would seem from your description that your molding practice is satisfactory, although the lack of risers might be criticized since the alloy you describe might need more feeding and, therefore, risers might be necessary to provide that feeding.

Small bushings, because they are cooled more rapidly do not exhibit as clearly the presence of the absorbed gases. Were you to examine them under a microscope, you undoubtedly would find trouble similar to that in the larger castings.

Porosity Caused by Metal Boiling in Mold

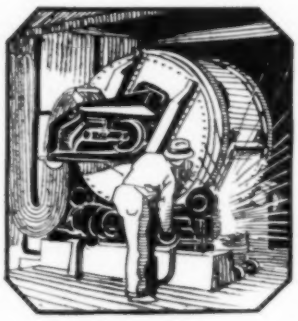
We are forwarding a combination gas tank and crankcase cover for a power lawn mower. These aluminum castings leak in the wall separating the tank from the crankcase. The mold is made in a three-part flask, from sand as dry as it is possible to use, gated on the bottom at the sides, poured two up with risers on top of the tank. The core is made from open sand, blacked and suspended from the cope. We have tried chilling the affected area, but without result.

The casting presents an excellent surface appearance except in the affected area where the blistered surface shows that the metal was in violent agitation. This agitation in turn is reflected in the porosity of the metal in the immediate vicinity. Agitation of the metal is caused by steam. Obviously the remedy lies in the prevention of steam formation at this point. A certain amount of steam is created where the metal climbs over the mound of sand forming the inside of the crankcase. Therefore this mound of sand should be vented and provision made for the vent to escape readily between the bottom edges of the drag and the bottom board.

The V-shaped sand projection between the crankcase and the tank is a potential steam developer on account of its shape. We assume that a row of nails or wires is bedded in this sand body for reinforcement. In accordance with ordinary foundry practice, it is quite probable that the molder dips these nails or wires in water, claywash or paste. As a result the water content of that body of sand is higher than usual. Omit the moisture from the nails and vent the pocket from the joint of the cheek downward.

The position of the tank core shows that your method of securing it in place is not quite satisfactory. The metal thickness on the bottom is twice that of the thickness on top. Also the metal thickness at one end is greater than that at the other end. This may be a contributory factor to the porosity, since the core probably did not *lift* until the mold was filled, thus encouraging a shift of metal to the affected area after the metal had lost its first fluidity. For lack of information, we cannot offer an opinion on the gates, but they also may be partly responsible. Extremely heavy gates at the bottom will draw metal from the casting. More satisfactory results would be secured by molding the casting in the opposite direction. It is not necessary to black wash the core in this casting.

Viewing Foundry Developments



At Short Range

SILICON carbide briquets for adding to the cupola charge have been developed recently. With a charge consisting principally of steel scrap, the briquet addition, which is made with the lime charge, is said to produce an exothermic reaction in the cupola thus increasing the temperature of the metal. A change in the distribution of the graphite results, and castings produced from metal to which the briquets have been added have a high brinell and good machinability.

♦ ♦ ♦

A copper-nickel-tin bronze, containing approximately 8 per cent nickel, recently has been developed. This alloy is responsive to heat treatment, and, while remaining tough, develops an elastic limit of 55,000 pounds per square inch.

♦ ♦ ♦

One manufacturer of automobiles makes a cast iron brake drum of the following composition: Total carbon, 2.50 to 2.75 per cent; silicon, 2.20 to 2.40 per cent; molybdenum, 0.60 per cent; manganese, 0.60 per cent; phosphorus, 0.20 per cent maximum and sulphur 0.10 per cent maximum.

♦ ♦ ♦

DEOXIDATION and degasification of metals and alloys is of considerable interest due to the difficulties imposed in commercial melting practice of maintaining an exactly neutral furnace atmosphere. Various elements including phosphorus, silicon and manganese are used for that purpose in nonferrous metals and alloys, but recently a patent has been granted on the use of sodium for deoxidation and degasification of brass. The sodium is added in the form of a sodium-zinc alloy containing 2 per cent sodium or as sodium-lead containing from 15 to 31.5 per cent sodium. The amount of sodium added is 0.10 per cent and upward depending upon the oxide and gas content, and in addition to deoxidizing and degasifying the brass, it is claimed that a finer grain structure is obtained.

♦ ♦ ♦

It is said that bismuth through the facility with which it forms bismuth trioxide may be used as a deoxidizing and softening agent in gray iron up to 2 per cent. However, while it lowers the brinell hardness and improves machining properties, it lowers the tensile strength of iron somewhat.

♦ ♦ ♦

ONE English firm having considerable spent cyanide from its steel heat treatment pots found that it gave good results as a fluxing agent in the cupola. The amount used could not be over 10 per cent as beyond that point severe attack on the lining ensued. It is said that application of the spent cyanide resulted in the graphite being finely divided, a close texture iron, and increased mechanical properties.

♦ ♦ ♦

A proprietary composition for nonmetallic molds of the so-called permanent type is composed of 3 parts of chrome ore, 1 part of fused silica, and 1 part of bentonite. The materials are ground finely, mixed with water and then rammed into mold form. The mold is baked under gradually increasing temperature until the latter exceeds 1800 degrees Fahr. for several hours. After cooling the mold is examined and corrected for accuracy. Before use the mold surface is coated with finely ground clay suspended in sodium silicate, dried, and then coated with lamp-black. The latter coating is repeated between every cast.

♦ ♦ ♦

Sodium has been suggested as a deoxidizing agent for iron and steel, but due to its peculiar physical properties in the metallic state, considerable difficulty has been encountered in incorporating in the molten bath of iron or steel. In general its light weight and low ignition point militate against its use. To overcome those characteristics a recent patent discloses a method whereby the metallic sodium in definite quantity is added through the bottom of the ladle. The device consists of a tube formed into a 90-degree elbow, a cylinder and a plunger mounted horizontally. Metallic sodium placed in the cylinder is forced through the tube by the plunger.

♦ ♦ ♦

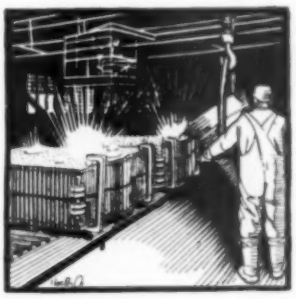
Installing electric furnace transformers outdoors has been made feasible by the development of a low voltage weather proof bushing for terminals of secondary bus bars.

♦ ♦ ♦

CHROMIUM up to 0.50 per cent now is being used commercially in malleable castings. Effect of chromium in preventing the annealing operation is overcome by increased silicon. A number of test bars containing 0.30 per cent chromium with 1.40 per cent silicon averaged about 80,000 pounds per square inch in tensile strength with over 9 per cent elongation.

♦ ♦ ♦

To avoid difficulties in casting brass, bronze or copper inserts in aluminum or aluminum alloy castings, a western foundry is spraying



the inserts with a coat of aluminum before placing them in the molds. An oxyacetylene spray gun is used to apply the coating.

♦ ♦ ♦

After an experience in welding sand holes in the teeth of a large gear thus resulting in a considerable saving, a steel foundry in the East has made the oxyacetylene blowpipe a standard reclamation method in filling up sand holes and flaws.

Men of Industry

Whose Activities Are Making Foundry History

FRANKLIN R. HOADLEY, newly elected president of the Gray Iron Founders' society, has been identified with the Farrell-Birmingham Mfg. Co., Ansonia, Conn., and with its predecessor since his graduation from Yale in 1914. He was born in Ansonia in 1890 and received his

Franklin R. Hoadley

elementary education at Hill school, Pottstown, Pa. He became connected with the Farrell Foundry & Machine Co., Ansonia, as foundry apprentice in 1914. During the war he was in the service as lieutenant in the ordnance department stationed in Buffalo and later overseas. On his return and discharge from the army, Mr. Hoadley was re-employed by the Farrel company as foundry manager in 1919. He was elected a director in 1923 and on the merger with the Birmingham Iron Foundry Co., Derby, Conn., in 1927, became a director of the newly formed Farrell-Birmingham Foundry & Machine Co., Inc., manufacturer of heavy machinery, operating plants in Ansonia, Derby and Buffalo. He was made vice president in 1930, a position which he still occupies.

Mr. Hoadley has been active in civic affairs, is a director of the Birmingham National bank, Derby, Conn., served as an alderman in Ansonia for 2 years, is chairman of the National Re-employment office for a number of towns in Connecticut and is a member of the CWA district committee. He is a member of the American Foundrymen's association, a major in the ordnance reserve, a member of the Army Ordnance association and serves on the administrative council of the National Founders' association.

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EDWARD N. HURLEY JR., president, Hurley Machine Co., Chicago, has been re-elected president of the American Washing Machine Manufacturers association.

❖ ❖ ❖

JOHN B. STRAUCH, president, National Metals Corp., St. Louis, has been elected a member of the board of directors of the General American Life Insurance Co. of St. Louis.

❖ ❖ ❖

DR. ING GUIDO VANZETTI, son of the late Ing. Comm. Carlo Vanzetti, has been elected to the post of managing director of the firm founded by his father, Fonderia Milanese Di Acciaio Vanzetti, in Milan.

❖ ❖ ❖

ALBERT WEBER has returned to America to assume the active management of the Pontiac Pattern & Engineering Co., Pontiac, Mich., following several months' engagement as consulting advisor on foundry matters to Citroen Co., Paris. During his European visit, Mr. Weber found opportunity to inspect manufacturing operations in England, Germany and Switzerland as well as in France.

❖ ❖ ❖

HENRY M. HALSTEAD JR. recently was elected executive vice president of the Gray Iron Founders society, Cleveland. Following his discharge from the navy in 1919, Mr. Halstead's business activity has been largely with the management and operation of manufacturing establishments in this country and abroad. During a period of 5 years he was in the New York office of the International Western Electric Co., the export subsidiary of the American Telephone & Telegraph Co., and in January, 1924, was assigned to Antwerp, Belgium, as production control manager. He completely revamped and reorganized the business and manufacturing procedure and during his first four years in Belgium, the factory increased its output 400 per cent with the personnel advancing from 2500 to 11,000. Early in 1930 he

Henry M. Halsted Jr.

became associated with the European general staff as production supervisor responsible for production control work in all European plants of the company. The items manufactured covered telephone, radio, broadcasting printing, telegraph, electric refrigeration, railway signaling and miscellaneous products.

In September 1925 the International Western Electric Co. was purchased by the International Telephone & Telegraph Corp. and the name was changed to International Standard Electric Corp. Following his successful administration as a member of the general staff of the company, Mr. Halsted was made assistant to the vice president in charge of European activities until 1932 when the European staff was abolished and supervision was established from the New York office. Mr. Halsted became connected with the NRA in Washington in August 1933. He is 37 years of age and was

graduated from Williams college, Williamstown, Mass., in 1918.

JOHN B. CAMPBELL has been appointed general manager, Pettibone-Mulliken Co., Chicago, succeeding C. H. Eib who resigned recently.

A. T. PERKINS, Chicago, recently was re-elected president of the Webster Mfg. Co., Tiffin, O. E. P. McPherson and Charles S. Clarke, both of Chicago, were re-elected vice president and secretary-treasurer respectively.

ROBERT E. KENNEDY, technical secretary, American Foundrymen's association, Chicago, has been appointed American representative of the study commission of the International Association for Testing Materials on Cast Iron, by the Amerian Society for Testing Materials. The committee is under the chairmanship of Dr. F. Korber, Germany.

R. GREENWOOD, managing director, and J. H. RIVERSA chief designer of Craven Brothers Ltd., Manchester, England, recently visited Moscow, Russia, at the invitation of the U.S.S.R. Central Engineering authority to discuss new business. The company during the past 2 years completed large contracts for machine tools for the Russian government.

C. R. MESSINGER, recently president of the Oliver Farm Equipment Co., Chicago, has been elected president of the Chain Belt Co., Milwaukee, succeeding his brother, the late C. F. Messinger. At the same time he has been made chairman of the Oliver company.

Mr. Messinger was made president of the Chain Belt Co. in 1923, but resigned in 1930 to become chairman of that company and president of the Oliver Farm Equipment Co. His recent office with the latter company has been filled by M. H. PETTIT, formerly vice president of the J. I. Case Threshing Machine Co., Racine, Wis., the Simmons Co., and the Nash Motors Co., Kenosha, Wis. Recently he has been associated with the federal Agricultural Adjustment administration.

RALPH F. TILLMAN has been made president of the Industrial Steel Castings Co., Toledo, O., succeeding his father, the late Joseph L. Tillman Sr. JOSEPH L. TILLMAN JR. was named vice president and secretary of the company. C. C. SMITH, formerly vice president, has been made director of sales and LAMBERT TILLMAN was re-elected treasurer. RAYMOND L. TILLMAN was named assistant secretary. W. E. WINE, president of the Wine Railway Appliance Co., was elected chairman of the board of directors of that company and a member of the executive committee of the foundry company. LAMBERT J. TILLMAN was elected president of the Wine Railway Appliance Co.

C. B. MAGRATH, president, North Western Foundry Co. and Greenlee Foundry Co., Chicago, has been elected vice president of the Gray Iron Founders' society. Mr. Magrath was born in Lethbridge, Alberta, Canada, in 1889. Following his elementary education he was graduated from McGill University, Toronto, in 1910 with a degree of bachelor of science. In 1911 Mr. Magrath was graduated from Massachusetts Institute of Technology, Boston, with the degree of master of science. He was employed for a short time in the foundry department of the International Harvester Co. in Chicago, then removing to Lethbridge where he operated the Lethbridge Iron Works, Ltd. until the outbreak of the European war. He served overseas 3½ years with the Canadian Expeditionary Force in the artillery service, returning to Chicago in 1919 at the close of the war. He was employed as an engineer for the Consumers Co., Chicago until 1924 when he was elected president of the North Western and Greenlee Foundry companies, a position which he now occupies.

Charles B. Magrath

JOHN DUFFY has been appointed superintendent of the foundry department, Federal Mogul Corp., Detroit. Mr. Duffy was educated at Rutherford college, Newcastle-on-Tyne, England, specializing in iron and steel manufacture. He received his foundry training under his father at Messrs. John Spencer & Sons, Newburn-on-Tyne. After working some years as journeyman molder in various shops in England, he was given charge of the molders at the Electro Flex Co., Dunston-on-Tyne. Coming to America after the war, Mr. Duffy first was connected with the Bliss Co., Brooklyn, N. Y., and later with the Newport News Shipbuilding & Dry Dock Co., Newport News, Va., as foreman molder. He resigned the latter position to become foundry engineer with Fairbanks Co., Binghamton, N. Y., in charge of both their iron and brass foundries. He next was associated with the Worthington Pump & Machinery Corp., Harrison, N. J., as foundry superintendent in charge of the nonferrous foundry.

Recently Mr. Duffy has been connected with the Troy Sunshade Co., Troy, O., as foundry superintendent. Following the Philadelphia convention of the American Foundrymen's association, he went to Milwaukee, as metallurgist to the American Metal Products Co. While there he made some interesting experiments in the production of a high test iron using molybdenum as the alloying element.

Pittsburgh Group Hears Talk on Castings

"Common Sense Investigation of a Defective Nonferrous Casting" was the subject of an address by R. R. Clarke, foundry superintendent, Erie, Pa., works of General Electric Co., Schenectady, N. Y., before the Pittsburgh Foundrymen's association's monthly meeting Jan. 15 at the Ft. Pitt hotel, Pittsburgh.

Talks on Costs

A round-table talk on "Foundry Costs and Methods of Estimating" led by W. M. Birs, assistant treasurer, Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn., featured the meeting of the Connecticut Foundrymen's association held at the Home club, Meriden, Conn., Jan. 19.

Moves Supply Firm

Independent Supply Co., established in 1930, recently has removed to new quarters at 2143 Bay street, Los Angeles. Steven Mocsny, formerly a foundryman in the East and for 5 years connected with the Snyder Foundry Supply Co. of Los Angeles, is manager. A. M. Barker, formerly connected with S. Obermayer Co., and previously with Rogers Brown Co., also is connected with the Independent Foundry Co.

F. M. McCarthy, Columbus, O., has been made foundry representative in Ohio for the Ironton Fire Brick Co., Ironton, O.

Prevent Losses with

Proper Gates and Risers

BY PAT DWYER

AT FIRST glance it appears that a saving in weight of sprue scrap similar to that described in the preceding article is effected by multiple pouring of small castings, where a number of molds are stacked on top of each other and poured through a common sprue or runner. A more detailed examination of the subject shows that this assumption does not hold, at least so far as the diameter of the sprue that can be used is concerned.

Reference to Fig. 223 will make this plain, where a series of small castings *A* are poured through a common sprue *B* and through gates *C*. The pouring of the lowest casting and the lowest section of the sprue, from level 1 up to level 2, is in no way affected by the fact that there is additional sprue extending above level 2. The size of the sprue and gate necessary to pour the lower casting is exactly the same as if this casting was to be poured alone. The sprue then fills up to level 2 and the second casting is filled just as if there were no others either above or below it. No reduction in size of sprue can be made on the score of reduced friction of cold metal rising in the mold, because there never is any question of pouring castings of greater height, but merely of a runner of greater height. Height of the sections of sprue appertaining to each casting is not necessarily any less than the height of the sprue used in pouring the castings singly.

Sprue Feeds the Casting

However, multiple pouring effects a certain saving in runner scrap in two ways. The first applies to where the sprue acts as a sinkhead and feeds the casting after pouring ceases. When the castings are poured singly, the sprue has to be so thick and high that it will stay molten long enough to provide the necessary metal to feed the casting. With a common sprue for several castings at different levels, the metal in each section of the sprue helps to feed the section below, both during and after the pouring of the lower section. Thus the length of sprue per casting—and possibly the diameter—may be reduced to some extent.

The second source of saving lies in the elimination of the cup shaped runner tops. One runner for a stack of molds instead of from six to twelve individual runners each with its own small cup at the top, means a saving of just that much metal. However, the amount is not necessarily considerable, since use of a cup shaped top on the sprue is not always essential.

A certain amount of metal will be saved in spattering since the pourer merely has to fill to the top of but one runner for any six or 12 flasks, instead of to the top of from six to 12 runners. It is not necessary to run metal over the tops of the flasks in pouring and a good pouring gang will not waste much metal by slopping, so that the saving in metal from this source will not amount to much with careful workmen. The chief advantage of multiple pouring is not so much the saving in sprue scrap, as the economies effected in floor space, top weights where snap flasks are employed, and the elapsed pouring time.

Compare Heads

POURING multiple or stacked molds presents certain advantages, but the saving in metal in the sprue scrap does not amount to any considerable item. The feeding head is a necessity on nearly all steel castings, but in many instances the effectiveness of the head may be increased if proper attention is paid to the various other contributory factors essential to the production of sound castings. Thus the position of the casting in the mold, the size and position of the gate, the temperature of the metal and the speed of pouring must be regulated to minimize sudden and unnatural shrinkage and thus relieve the head from carrying the major load. Steel or any other metal shrinks according to an immutable law and advantage should be taken of the supplementary law of gravity in designing a head that will supply feed metal to the casting.

From the foregoing and from other factors referred to previously it is apparent that in designing and locating sinkheads, it is important to place the casting in the mold and to distribute the chills so that the maximum amount of feeding will be done (1) during pouring, by the hot metal running into the mold (2) by the heavy sections of the casting which feed the light sections placed below and (3) by the heads during the time they actually are being filled, preferably from the top with fresh, hot metal.

On many castings it is impossible to take advantage of all these methods. However, by careful arrangement, generally it is possible to utilize one or more, so that the heads are levied on for the least possible amount of feeding metal after the pouring has ceased.

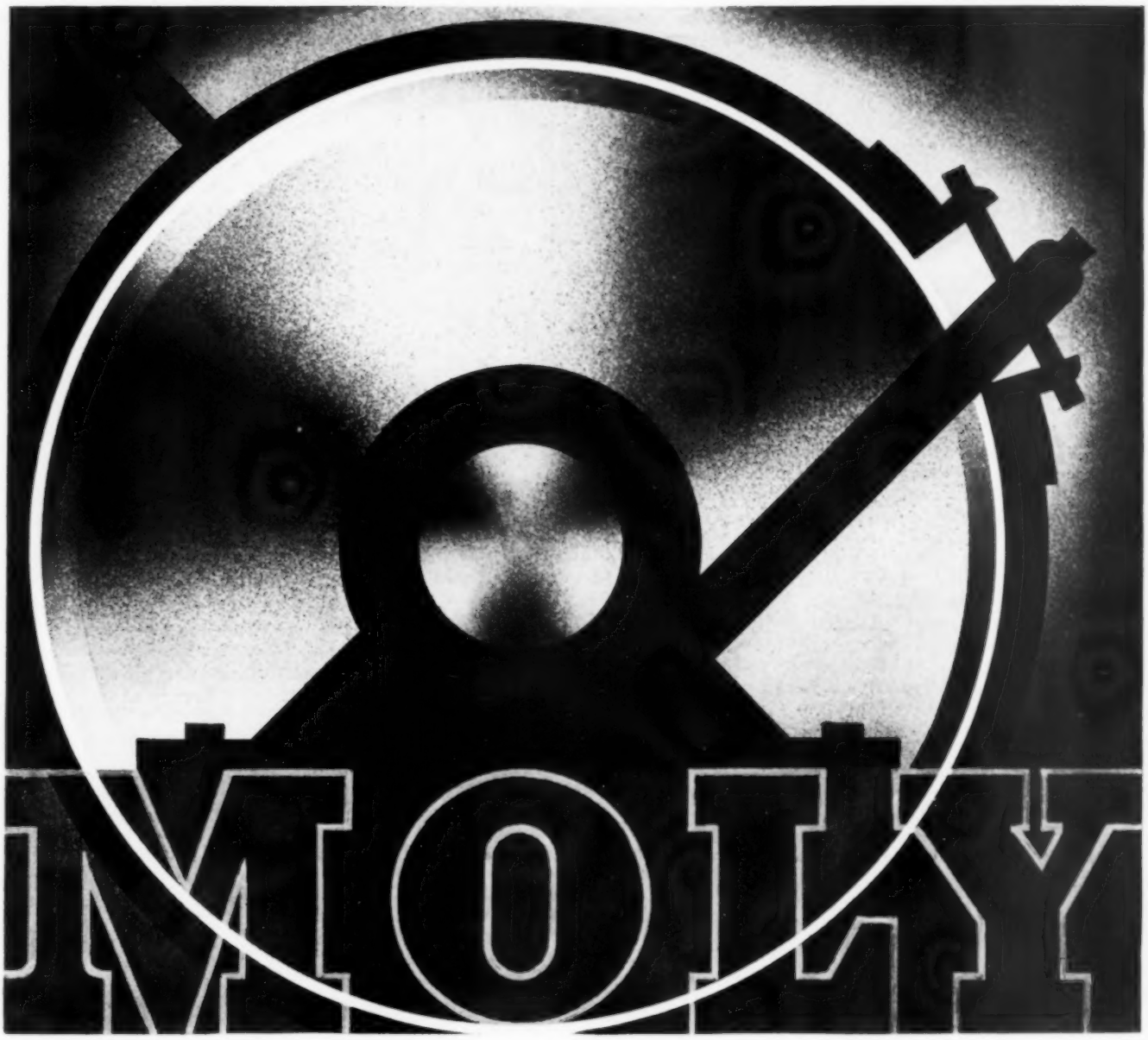
Select Size of Head

In designing and placing heads, the first consideration should be how far the work of feeding can be taken away from them and put some place else. The second consideration is the size of the head to be used in relation to the size of the section to be fed, and especially in view of the size of the neck through which the metal has to pass.

Usually, the thickness of the neck is fixed by that of the portion of the casting upon which the head is set. This in turn involves the law of fluid pressure mentioned in the immediately preceding article in this series. According to that law and from one point of view, if the diameter of the neck is small it is quite useless to place a very wide head. A head of that kind exerts no more pressure than a head of equal height and the same diameter as the neck, upon the metal in the neck. So far as exerting pressure upon the neck is concerned only the height of the head is effective. From this point of view the best head is one in which the diameter equals that of the neck and of sufficient height to contain enough metal to do all the feeding that will be needed.

In viewing this subject from another, that is from a practical operating angle, it becomes readily apparent that a high and very narrow head in-

(*Continued on page* 32)



for wear . . .

GREEK meets Greek when two wearing surfaces engage each other under vise-like pressure and heavy opposing forces. The brakes on traveling cranes and other hoisting machinery furnish an example. Based on replacement costs, it is usually the drum, and not the band lining, which comes out second-best. This is true not only with ordinary carbon steel but even with most alloy-steels and irons.

It's a different story when Molybdenum is added. Under *any* formula it improves wear-resisting ferrous products. Molybdenum imparts a hardness — without brittleness — obtainable with no other combination of alloys at a competitive cost. *Comparative service tests have shown Molybdenum grey iron outlasting the usual steel drum three times with no appreciable wear as yet.* The depth hardness imparted by Moly to iron has made this application possible by affording sufficient strength to withstand the enormous torsional load.

Evidence in another field shows one automobile manufacturer doubling the life of brake drums with the addition of only 0.20% Molybdenum. . . . And what is true of one form of application is true of others — be they brake drums, cast steel dipper teeth, flat machine bearings or what-not.

Wear resistance is only one of the many desirable qualities of iron and steel which thousands of service tests have demonstrated can be improved with Molybdenum. Have you a problem of equipment upkeep involving wear; torsional, vibrational or sheering stresses; creep, growth or heat resistance? The modern Climax laboratories in Detroit, with their free engineering service, are at your disposal. Meantime, write for our latest Cast Iron booklet. Climax Molybdenum Company, 295 Madison Avenue, New York City.

CLIMAX Mo-lyb-den-um

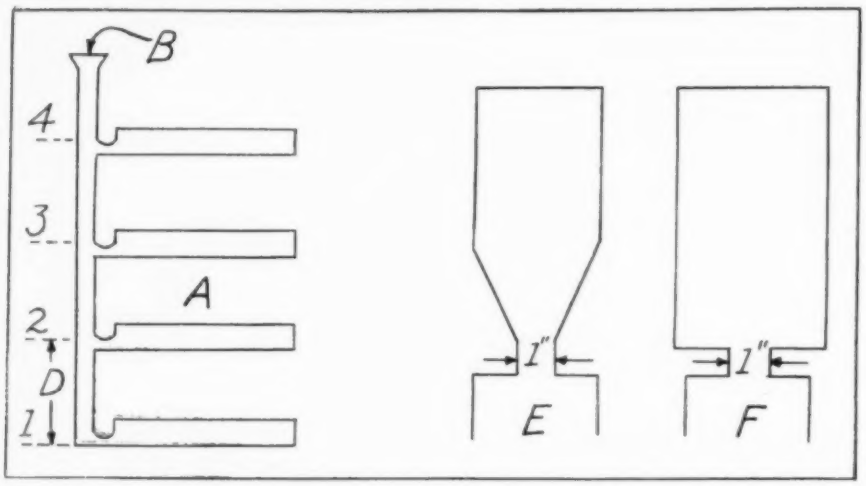


Fig. 222—A comparatively small runner will serve stacked molds. Head design marked F is preferable to that shown at E

(*Continued from page* 30)

evitably would freeze to the center and cease to feed long before the cavity had ceased to develop. Therefore the head must be of such diameter that it shall not freeze to the center until after the necessity for remaining molten ceases to exist.

In other words, the head at least must be as large, and generally larger, than the section of the casting it is designed to feed. It is quite useless to provide a head of just the right proportions, if the neck freezes before the head has ceased to feed. Hence the diameter of the neck must be great enough to prevent premature freezing.

The rate of cooling in a neck of given diameter is influenced greatly by the length and also by the shape of the head. Thus a long neck tapering upward to the full size of the head *E*, Fig. 222, will cool much more rapidly than a short neck of the same thickness as shown in *F* in the same illustration, where the short neck is kept hot by the closely adjacent mass of metal in the head and in the casting. The neck should be made as short and be joined to the head squarely.

Prevent Metal from Freezing

On many thick, heavy castings the sinkhead is not contracted in a neck, but is brought down full size to the casting. Danger of premature freezing in the neck is of course eliminated where the section to be fed is large enough to permit the use of a large, straight sinkhead.

Where the diameter of the neck is fixed, as for instance by the width of that portion of the casting to which it is attached, the neck should be made as short as possible, and the head should be made with a square bottom and no wider than will suffice to keep the interior liquid and maintain the feed up to the moment the neck freezes. All extra width beyond that necessary to accomplish this purpose represents a sheer waste of metal.

For a given diameter of head and neck, the height of the head also should not be greater than is necessary to provide enough metal to feed the casting completely. The head that has done its work to perfection will be hollow just down to the neck.

Heads 8, 10 and even 12 inches in diameter and 18 inches or 2 feet high, with necks only 2 inches wide and 3 or 4 inches high, contain fluid metal and are capable of feeding the casting long after the neck and even the casting itself have solidified. However, the reservoir of liquid metal in the head is quite useless for the purpose for which it is provided and may be compared to the dam on a power intake where the flume to the turbine is choked with mud or other foreign material. The liquid required to do the work is there, but it cannot flow to the place where it is needed.

Factors governing the proper size of head and neck for a given casting vary to such an extent that it is practically impossible to do more than estimate roughly by the light of previous experience how large they should be made and then allow an ample margin for safety. A casting with a given size of head may prove unsound, that is it may show a pipe under the neck when the head has been knocked or cut from the casting. The best means of remedying the trouble has to be considered.

In another instance the casting below the neck may be sound and the general assumption is that the proportioning of the head has been correct. So it has so far as making a sound casting is concerned. However, in many instances the margin of metal provided is too great. The waste in sinkhead scrap is excessive. The foundryman may find it worth his while to consider how much the sinkhead may be reduced in size without risk of making an unsound casting.

Given a section of a casting to be fed, a sinkhead and a neck connecting them, six different theoretical orders in which the three may freeze are represented diagrammatically from *G* to *L* in Fig. 223. The order of freezing is indicated and the shape and location that the cavities may be expected to assume are sketched. Of the six examples *H*, *K*, and *L* are of little interest as they involve the freezing of the head before that of the neck. This condition seldom will be found in practice, at least under ordinary circumstances.

Head Forms Own Pipe

Commencing with example *L*, the head, neck and casting freeze successively in the order indicated. The metal at the bottom of each is sustained by the still liquid metal beneath. Each section will form its own pipe. Two of these pipes probably will be more or less double ended as shown in the illustration.

Similarly in example *K* the head will form its own pipe. Then the casting in freezing and piping in all probability will drain the neck, which then will freeze last and pipe at the top, forming a continuation of the pipe in the casting. Should the neck contain enough metal to feed the casting completely, of course this pipe would appear only in the neck and not extend into the casting.

In example *H* the casting would

(*Continued on page* 35)

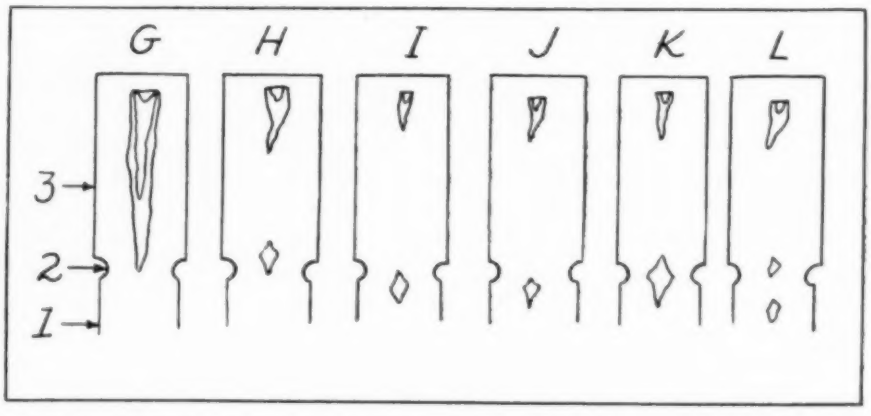


Fig. 223—Sectional view of a series of feeding heads illustrating shrinkage of the casting under varying conditions

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(*Continued from page* 32)

freeze first and the pipe in the casting would be filled from the liquid metal supply above. Then the head would freeze and form a pipe and lastly the neck would freeze and develop a pipe as shown.

Where the head freezes before the neck as in cases *K* and *L*, generally it will be found that the casting has shrunk before the head solidified and has drained the neck. In either case probably a more or less continuous pipe will be found running through the neck and up into the head. The same condition often will be found in example *H*. A neck frozen later than the head generally will be hollow with the pipe extending a little way up into the head and in many cases extending down into the casting. The remedy is a wider head, which in some cases may be made shorter than the original. This point is determined by the depth of pipe in the upper part of the head.

Cases similar to *G*, *I* and *J* will be found in practice. Case *G* may involve a head, neck and casting all piped as indicated by the deepest pipe shown in Fig. 223. In this instance obvicusly there was not enough metal in the head to feed the casting. The remedy depends on the thickness of the shell of the frozen head and neck. If it is very thick and if the pipe is narrow, it is apparent that if more metal is added by merely increasing the height of the head, the head and neck will freeze tight before this extra metal can reach the casting and the result will resemble that shown at *I*. Manifestly what is needed is a wider head and neck and perhaps also a higher head. Increased height exerts greater pressure on the neck and will force more metal through when the neck is frozen nearly to the center.

Increase the Height

Increased height of the head and a slight increase in the diameter are needed if the walls are thin, indicating that the metal ran out through the bottom much faster than it froze. However, an exaample of this kind also may indicate that if the ladle had been kept over the head a little longer and the shrinkage fed by slow pouring at the last, the casting might have come out all right with the original head and neck.

Where the casting and neck are sound and the pipe in the head comparatively shallow, it is apparent that the head is too great and that metal has been wasted. The size of the head then quite properly may be reduced in height and probably also in diameter until the pipe extends nearly to the bottom, or to the intermediate positions of the pipe in the illustration.

By far the most common cause of piping in castings is shown in *I* and *J* where the metal in the neck solidified first. In example *I* the final solidification of the casting occurred next after that of the neck, while in example *J* the casting solidified last. Usually the pipe in example *J* will be deeper because the beginning of solidification and pipe forming was deferred for a longer period after the neck closed and as a result less feeding occurred in the preliminary period of pipe forming. This pipe will run up into, but not through the neck, since the upper part of the neck will have been fed by the head in both cases. In both cases also a pipe will appear in the upper part of the head.

The immediate remedy is a wider and if possible, shorter neck. In this instance the question is not one of enough metal to feed, but of a prematurely choked feed channel. The size and depth of the pipe in the upper part of the head will indicate further whether the head contained too much or to little metal to complete the feeding had a neck of the proper size been provided.

From the foregoing presentation it will be seen that small necks designed primarily to facilitate knocking the heads off with a sledge hammer, drop ball or burning them off at least expense are not conducive to the production of sound castings. The metal in the restricted neck will freeze first and the result will be a pipe in the casting which will have to be plugged by the welder.

This added expense often more than offsets any saving effected in the cost of removing the head. Where the pipe is irregular and partly discontinuous the plug merely may fill the top of the opening like a cork in a bottle and leave the casting dangerously weak. Broken castings occasionaly disclose this form of defect. Indiscriminate hole plugging may cause acceptance of castings on a first order, but if many of these castings break and show cavities and defective areas, it is fairly safe to assume the customer will place further orders elsewhere.

Minimum length of neck may be secured in a special core. Although considerably narrower than the head in at least one dimension, it will feed quite efficiently. The core is so thin and the neck consequently so short in this method of molding, that the mass of hot metal in the closely adjoining head and casting quickly brings the core to a high temperature and thus keeps the neck metal fluid.

By properly shaping the opening in the core, the neck may be broken from the casting safely, even though quite heavy. However, care has to be exercised not to knock off too heavy a neck or one that is not shaped just right whether in the original design or by the partial disintegration of the core. The heavy shock of the blow upon a casting already full of shrinkage stresses may crack the casting.

Where no neck appears and the head is of uniform cross section from the top to the junction with the casting,

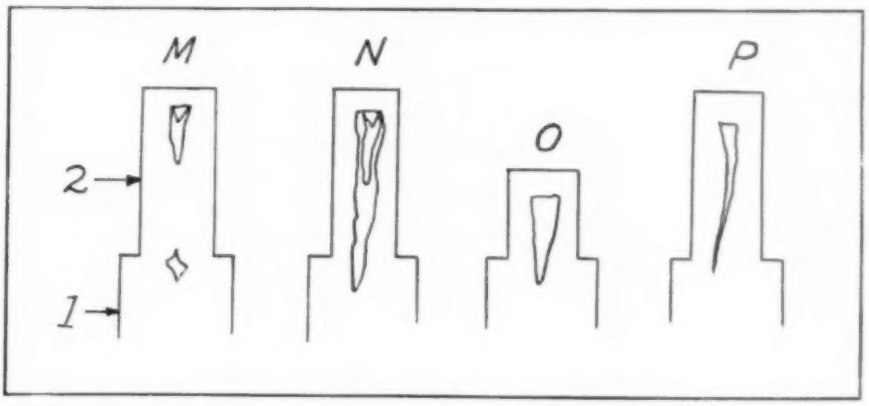


Fig. 224—In straight heads without a neck and of insufficient volume or height the shrinkage cavity will extend into the casting

freezing may occur in only one of two orders, head first or casting first. The probable shape of the resulting pipe in several examples is shown in Fig. 224.

When the head freezes first it will form its own pipe. The casting then will freeze and the pipe formed in it probably will run up a little way into the head. When the casting freezes first it may be sound. If the pipe in the head extends down a little way as in the upper cavity *N*, the head has been made too high and perhaps too wide. If the pipe in the head goes quite deep but does not reach the casting—second cavity *N*—the size of the head is theoretically correct. Should the pipe reach the casting—outside and longest cavity *N*— it may be very wide. The walls of the head are thin and will appear as at *O*. This condition calls for a higher perhaps a wider head. Greater diameter of head is the obvious remedy for the head shown at *P*, where the walls are very thick and the bottom part of the pipe very small.

This is the forty-ninth of a series of articles dealing with the various types of gates and risers used in the foundry industry. The fiftieth will appear in an early issue. THE EDITORS.

Ancients Manipulated Metals

Early writings show that founding was one of the first of the mechanical arts

By H. E. WHITE
Lava Crucible Co. of Pittsburgh

DISCOVERY of fire naturally antedated even the first crude attempts at practice of the metallurgical or ceramic arts. Paleolithic man probably observed natural phenomena, storms sweeping over desert and plain, vivid lightning, a tree struck by a thunderbolt and flaming up; or it might be a volcanic eruption with an aftermath of blazing forest and glowing cinders.

Man probably knew fire before he discovered how to make it. Sparks occasionally flew from flint weapon or implement in course of construction. Primitive man soon learned to produce the vital spark from flint and from the bow and drill.

The savage who inadvertently built a fire on top of some easily reducible ore and discovered metal in the ashes; or who used copper ore to form his crude fire place for cooking his meals, instituted the bronze age. Founder's hoards of the bronze age scattered over western Europe indicate that smelting with charcoal was done in shallow pits.

Egyptians Used Forced Draft

Egyptian inscriptions show small furnaces with forced draft, in early cases with a blow pipe, but later, about 1500 B.C. with bellows. The remains of smelting appliances at Mt. Laurian (500-300 B. C.) do not indicate much advance over the primitive hearth. However, evidence at this locality shows ability of the smelters to separate minerals by specific gravity.

At the beginning of the Christian Era, Pliny refers to the upper and lower crucibles (a forehearth) and to the pillars and arches of a furnace. Both Pliny and Dioscordies describe distillation apparatus to recover quicksilver. The plant of a prehistoric copper smelter has been found in Spain and bronze foundry materials have been found in various localities.

References to containers for molten metal are few. Chinese history is filled with references to pottery, porcelains and the like and in this way we may trace the use of clay vessels for smelting metals.

Discovery of pottery has been credited to various ages, dynasties and localities. Roy Chapman Andrews discovered pottery ruins in Mongolian villages said to have been destroyed 20,000 B. C. Pottery also has been found in Indian ruins dating 7000 B.C. The Chous dynasty (1122-256 B.C.) has been credited with the discovery of pottery. Later this has been disproved, but undoubtedly there was decided advance in the manufacturing during that period.

An ancient legend describes Shen Nung, a Chinese emperor (2737 B.C.) as the inventor of the plow and also the first maker of pottery.

A forge and a kiln stand at the entrance gate of civilization and apparently the kiln was there first. Probably primitive man observed depressions in the surface of the earth filled with water after a rain. He dug around them and eventually dug them out. Later he learned to form duplicates in clay.

In Egyptian hieroglyphics the crucible is the emblem of copper, which would seem to indicate that crucibles were used for refining. The earliest source of Egyptian copper probably was the Sinai peninsula where crucible fragments have been found. Reliefs dating as far back as the time of Senefern (about 3700 B.C.) indicate that he worked the copper mines.

Agricola used the word *Catinus* for crucibles, furnace wall, forehearth, dipping pot, tapping pot, receiving pot, etc.

An alchemist of the Middle Ages has left the following directions for preparing a crucible for smelting copper: "Take an iron dish and line it inside and out with clay strongly beaten and mixed, and see that it is carefully dried. Then place it before the forge on the coals so that when the bellows act upon it, the wind may issue partly within and partly above it and not below it."

Copper undoubtedly was discovered between 6000 and 7000 years ago, probably in the Neolithic Age. For a long period bronze axes and other implements were cast in molds to the shape of the stone implements they were superseding. Copper objects were common in Egypt throughout the three first dynasties (4400-3766 B.C.) and bronze articles have been found that date from the fourth dynasty (3766-3600). A hammered bronze vase attributed to 4000 B.C. has been found in Crete and is said to be the oldest metal vessel in existence.

In China, Hungary, Cornwall and elsewhere, copper ore and tinstone are found in the same vein. Rather through ignorance than knowledge the ancient smelters hit upon a harder and better bronze, an alloy of copper and tin. In India where copper and zinc appear together brass was hit upon similarly by smelting the ore mixture while ignorant of the components.

Hittites Made First Iron

Early metals as mediums of exchange offered substantial wearing qualities, high value, and general and constant demand. Iron, first reduced from its ores by the Hittites was a rare and much desired substance. Aristotle states that iron was the first currency. Iron followed brass and copper 3000 years later. American metallurgy may have developed independently of the old world, or it may have been brought by the same peoples who carved elephant headed figures in Central America. These American peoples had advanced to the use of bronze and copper, but not to the use of iron before Columbus discovered America.

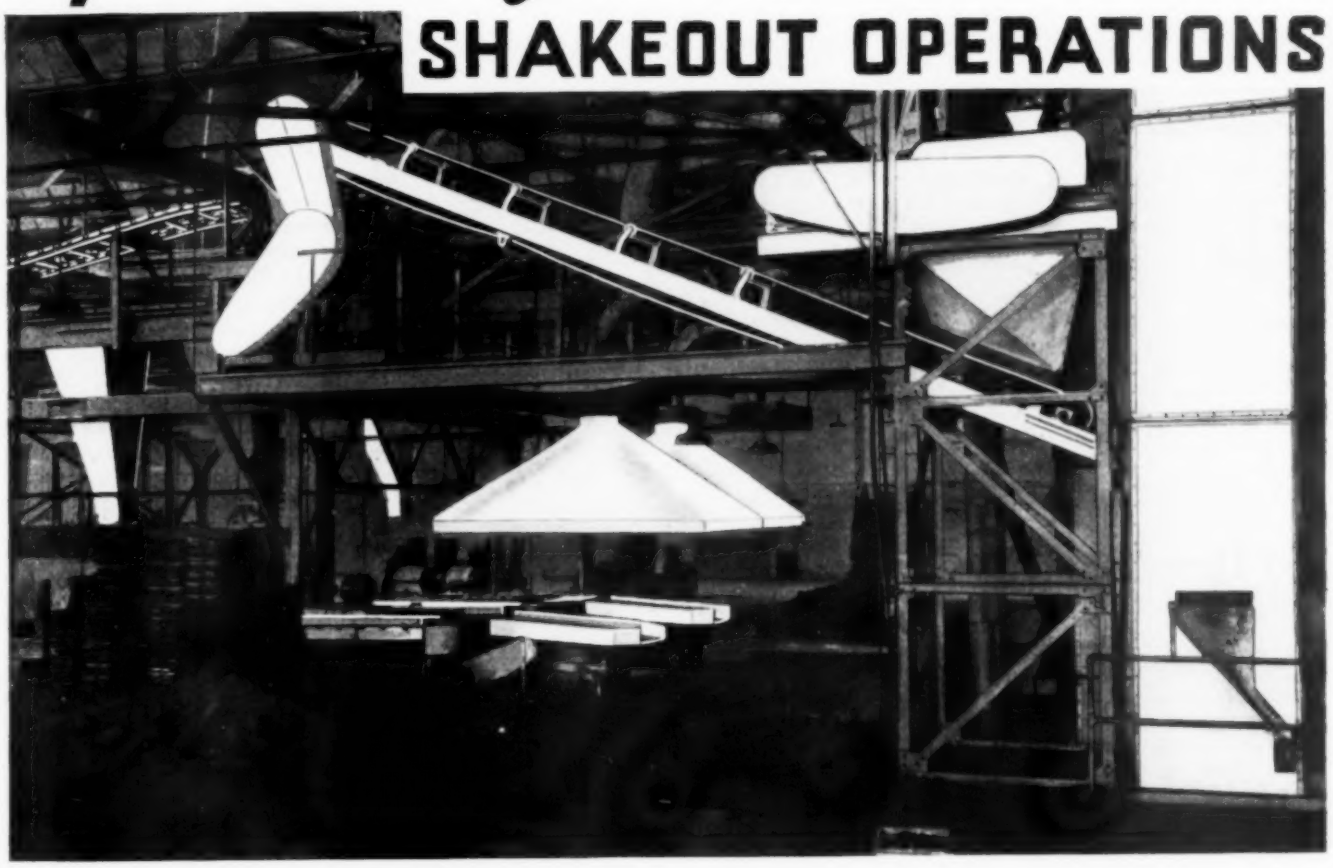
The first complete work linking metallurgical and ceramic practice *De Re Metallica* by Georges Agricola was published in Latin, in 1556, less than 100 years after the invention of printing by Gutenberg. In 1912 it was translated into English by Herbert and Lou Henry Hoover. The book has few references to historical dates, but the translators have added invaluable footnotes. From a modern standpoint these are of more value than the book itself. Definite dates have been tied up with discoveries and prehistoric use of various metals, alloys, and metallurgical practice.

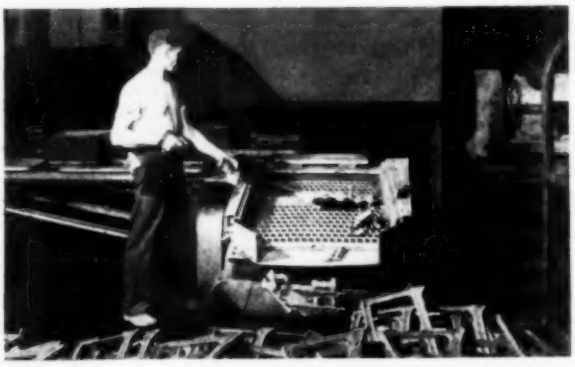
During 180 years Agricola's book was not superseded as a text book

(Concluded on page 38)

GOOD HOUSEKEEPING

provides for CENTRALIZED SHAKEOUT OPERATIONS





Link-Belt Conveyors Make For An Orderly Plant Arrangement

Isolation of the shakeout operation can be easily and simply arranged for, through the use of Link-Belt conveyors for molds, castings, etc. Each plant presents an individual problem in this respect. Often relocation or rearrangement will accomplish much in the matter of "good housekeeping", and Link-Belt engineers are ready to offer their experience to those interested in improving foundry conditions.

LINK-BELT COMPANY

CHICAGO PHILADELPHIA INDIANAPOLIS TORONTO

Offices in principal cities 4916

LINK-BELT

(*Concluded from page* 36)
and guide to miners and metallurgists. Until Schluter's great work on metallurgy appeared in 1738 it had no equal. Agricola describes the use of crucibles in metallurgical work and their manufacture from clay and ashes. He also describes the manufacture of cupels, retorts, muffles and scorifiers. Other references are found in earlier works, the *Probierbuchlein Nutzlich Bergbuchlin* (1527) and Biringuccio's *De La Pirotechnia.*

The practice of experimenting with material things was on the increase during the thirteenth and fourteenth centuries. Items of specific knowledge were won, but there was no co-ordinate advance. The work was done in a detached and furtive manner. A tradition of isolated investigation inherent in man and intensified from contact with the Arab came into Europe and a considerable amount of private and secretive research was carried on by the alchemists. These early scientists were in close touch with the glass and metal workers. They pried into many secrets of nature, but they were obsessed by practical ideas. They sought power through knowledge. They wanted to find out how to manufacture gold from cheaper materials. How to make men immortal by the elixir of life and other fantastic dreams of a like character. In their researches they learned much about poisons, dyes, metallurgy and other subjects. They discovered various refractory substances and worked their way toward clear glass and so to lenses and optical instruments.

Theophilus, a sixteenth century monk seems to have been somewhat mythical. A book on metallurgy attributed to him has been translated by Hendrie.

The world of today is much more disposed to spend money on technical research than on pure science. Half the men in our scientific laboratories continue to dream of patents and secret processes. For all our sneers at their memory we live today largely in the age of the alchemists. The so-called business man of today still thinks of research as a sort of alchemy, something that will return large dividends out of the air.

Engineers and Foundrymen Told Of Development in Ferrous Castings

NEARLY 500 engineers and others interested in the development and application of castings attended a meeting on castings development held Wednesday evening, Jan. 31, in Hotel Statler, Cleveland. The meeting was held under the joint sponsorship of the American Foundrymen's association, the Cleveland Engineering society and the Cleveland section of the American Society of Mechanical Engineers. Dan M. Avey, editor of THE FOUNDRY, presided.

Harry A. Schwartz, manager of research, National Malleable & Steel Castings Co., Cleveland, spoke on "Malleable Iron Castings." He described the practice and equipment employed in the production of malleable, discussed the metallurgy of the product, enumerated its various physical properties and touched on a number of typical uses.

Shows Malleable Progress

To show progress in improving the quality of malleable castings, Dr. Schwartz exhibited a chart showing changes in A.S.T.M. specifications for malleable cast iron dating from 1903 to 1933. He called attention to the two grades of malleable covered in the 1933 specifications and commented upon the fact that the railroads generally specified the higher strength castings and that the automobile industry, the largest consumer of malleable iron, prefers castings of lower strength but with greater machinability. In conclusion, Dr. Schwartz described a number of variations of malleable cast iron in which alloying elements have been introduced.

Discusses Gray Iron

Fred J. Walls, metallurgist, Eaton-Erb Foundry Co., Detroit, discussed "Gray Cast Iron." He touched upon important developments in the past three years and emphasized the growth of the centrifugal and permanent mold processes. He showed in considerable detail the unmistakable trend toward high strength cast irons, obtained through the use of nickel, molybdenum, chromium, titanium and other elements. He declared that progress in this direction is narrowing the gap which exists between the physical properties of gray iron, malleable and steel castings.

Mr. Walls exhibited a number of slides showing alloy iron castings for brake drums, camshafts, crankshafts, shafts, boiler forming dies, crusher rolls, and the like.

Major R. A. Bull, foundry consultant, Chicago, described the steel foundry industry, stating that it consists of about 275 plants whose average output per month varies from 25 to 7000 tons. The annual capacity of the industry is about 2,000,000 net tons per year and the value of products, when the industry is operating at capacity, is about $175,000,000.

Major Bull traced the development of steel castings and stressed the "alloy consciousness" which has marked the trend in steel casting progress during recent years. He declared that recent interest in welding of rolled steel and the recent introduction of high-strength cast iron also have helped to stimulate steel foundry practice.

Upper Limit Not Specified

In commenting upon specifications for steel castings, Major Bull declared that the 150,000 pounds per square inch tensile strength provided in specifications for certain alloy steel castings does not represent the upper limit of strength obtainable. Some steel foundries, he said, are working to 200,000 pounds stipulated in private specifications. Strength as high as 225,000 pounds are found in test bars of that metal.

The speaker cautioned engineers and designers against issuing specifications in blind adherence to high strengths and exact chemical analysis. He urged that buyers co-operate with the foundrymen to the extent of giving him some leeway in connection with strengths and analysis in order that he may provide a casting best suited to the consumer's needs.

A dinner immediately preceding the joint meeting was attended by 130 foundrymen, foundry equipment and supply manufacturers, and engineers. Following an introduction of speakers, officials of sponsoring organizations and members of the committee arranging the joint meeting, Robert E. Kennedy, technical secretary of the American Foundrymen's association, Chicago, outlined briefly the work of the association and the services performed for its members and the industry as a whole. The dinner was attended by representatives from various foundry centers in Ohio, and from Pittsburgh, Buffalo, Detroit and other cities.

Organize Company To Manufacture Ovens

The Smith-Mayer Corp., 15374 Euclid avenue, Cleveland, has been formed to manufacture industrial ovens, conveyors, air heaters, air conditioning and allied equipment by James Campbell Smith and C. F. Mayer. Mr. Smith, who has been engaged in private practice in the design of equipment, formerly was manager in Detroit for the McCann-Harrison Corp. and previously was Pittsburgh manager for the Swartwout Co., Cleveland. Mr. Mayer recently resigned as vice president of the Foundry Equipment Co., Cleveland. Previous to that time he was manager of the oven department of the Swartwout Co., Cleveland.

ADVERTISING PAGES OMITTED

Code Authority For Gray Iron Set Up

Henry M. Halsted, Jr. on Feb. 1 became executive vice president of the Gray Iron Founders society, and with Arthur J. Tuscany as executive secretary, will have charge of the administration and organization of the gray iron jobbing foundry industry under the code which is awaiting the President's signature. Mr. Halsted resigned his position as assistant deputy administrator of the NRA staff to assume his new position.

The offices of the Gray Iron Founders' society will remain in Cleveland. Administration of the code in addition to the executive officers mentioned will be under general direction of eight members of the industry, six from the Gray Iron Founders' society and two representing nonmembers. The code authority members elected by the Gray Iron Founders society include Franklin R. Hoadley, president, Gray Iron Founders' society, Farrel-Birmingham Mfg. Co., Inc., Ansonia, Conn.; W. A. Rigsby, Lombard Iron Works & Supply Co., Augusta, Ga.; A. B. Root, Jr., Hunt-Spiller Mfg. Corp., Boston; C. B. Magrath, North Western Foundry Co., Chicago; W. H. Winters, American Brake Shoe & Foundry Co., Pittsburgh; and George Branston, Campbell, Wyant & Cannon Co., Muskegon, Mich.

A ballot for the selection of the two code authority members to represent those not affiliated with the society will be taken as soon as the code is signed.

Book Review

Bulletin of the National Research Council, paper, 223 pages, 6¾ x 9¾ inches, published by the National Research Council of the National Academy of Sciences, Washington, and supplied by THE FOUNDRY, Cleveland, for $2.00 plus 15 cents postage and in Europe by the Penton Publishing Co. Ltd., Caxton House, Westminster, London.

This bulletin is the fifth edition and was compiled by Clarence J. West and Callie Hull. It lists 1575 industrial laboratories in which research is conducted. Laboratories connected with federal, state or municipal governments, or with educational institutions have been excluded as are the names of firms which are not actually supporting laboratories in their own works, and associations maintaining fellowships in certain educational institutions. The various laboratories are listed in alphabetical order, and information is presented on the research staffs, and the type of research work being conducted. Each laboratory is given a number, and that number is referred to in the cross indexing on locations as to state and city, and subject classification of laboratory activities.

Elected Vice President Of Supply Firm

James W. Early, sales manager of J. S. McCormick Co., Pittsburgh recently has been appointed vice president of the company. Mr. Early continues as sales manager of the organization.

James W. Early

Made Sales Manager

W. A. Nugent has been made sales manager of the Independent Pneumatic Tool Co., 600 West Jackson boulevard, Chicago. Mr. Nugent has been connected with that company for 19 years, serving as St. Louis branch manager, assistant to the president and in similar capacities, and recently was district manager of the Chicago territory.

Joins Engineering Staff

Carl Sieweke has joined the staff of the Campbell-Hausfeld Co., Harrison, O., where he will be identified with engineering and production on melting equipment.

General Electric Co., recently was presented a gold medal by the American Institute of the City of New York for pioneering in industrial research. The American institute, which was founded more than 100 years ago, includes among its objectives the recognition of achievements in science which have influenced prfoundly human affairs.

Power House Uses Steam from Waste Boilers

By L. S. Weimer

While a new chimney for the power house boilers was being installed, the Malleable Iron Range Co., Beaver Dam, Wis., produced sufficient steam to meet the needs of the plant with a 300 horsepower waste heat boiler. This unit is heated by waste heat from a 10-ton malleable iron air furnace which is fired with pulverized coal.

Data covering the average over a week on the operations including the tonnage of iron melted, coal used and the steam produced are as follows:

	Morning	Afternoon	Total
Time, hours	5	4	9
Charge, pounds	14,200	13,000	27,200
Coal, pounds	9,600	7,900	17,500
Steam generated pounds			117,600
Steam per pound of coal			6.72
Iron melted per pound			1.55
K.W. hours produced by steam			4,700
Maximum K.W. produced			720
Average K.W. produced for 9 hours			522

Cleveland Company In Business 60 Years

W. W. Sly Mfg. Co., 4700 Train avenue, Cleveland, is celebrating the 60th anniversary of the founding of the company. That organization specializes in foundry cleaning room equipment, including the exhaust type tumbling mill and modifications in the form of polishing mills and water tumbling mills, a line of pressure blast cleaning equipment consisting principally of blast cleaning barrels, tables, cabinets, rooms, tanks and accessories, and a line of dust collecting equipment.

The company was founded in 1874 by W. W. Sly, after an intimate contact with the foundry industry for a number of years. The organization first manufactured tumbling mills of the exhaust type, and shortly thereafter developed a cloth screen type dust arrester. Specialization in the foundry field led to the development of the present line of blast cleaning equipment.

From a small beginning the company gradually has grown to its present size, with representatives in New York, Chicago, Detroit, Milwaukee, St. Louis, Minneapolis, Seattle, Los Angeles, Chattanooga, Tenn., Houston, Texas, and Toronto, Canada.

Meet in New York

The 143rd meeting of the American Institute of Mining and Metallurgical Engineers will be held Feb. 19-22 at the Engineering Societies building, 29 West Thirty-ninth street, New York.

Cut Risers On Chrome-Nickel Steel Castings

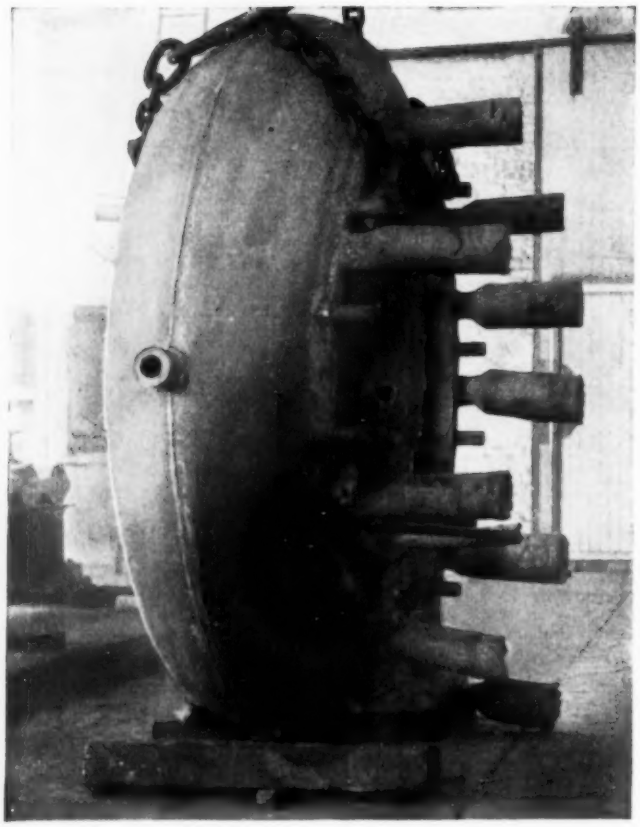


Fig. 1—Risers on this exceptionally large chrome-nickel steel casting were removed with the blowpipe

FOR years the steel foundry industry has removed risers by oxyacetylene cutting. When foundries first began to produce chrome-nickel steel castings, it was found that the customary oxyacetylene cutting procedure would not work with that type of oxidation-resisting steels, according to a recent article in *Oxy-Acetylene Tips*. Therefore, a thorough investigation was undertaken to determine the possibility of developing a cutting procedure which would be suitable for chrome-nickel risers.

While it may seem incongruous to speak of using oxygen for the removal of oxygen-resistant steel, the method developed does just that. In the first work done, a steel feeder rod was used to aid the oxidation process. That is, a steel or iron rod was fed into the kerf while the cut was being made. Obviously this could be applied only to small risers because it necessitated using the blowpipe with one hand while the rod was fed in by the other. Such cuts were slow and expensive.

Further study led to the development of satisfactory technique. As a result, the cutting of chrome-nickel steel risers, particularly those of the type known as "18 and 8", has been done on a commercial basis over the past 3 years.

For this work an injector type cutting blowpipe is used. As a lot of heat is necessary, it is recommended that one size larger nozzle be used than would be the case were the casting of plain steel. The nozzle preferably should have six preheating jets. Oxygen hose should be $\frac{3}{8}$-inch diameter to secure ample volume. Oxygen pressure needs to be increased perhaps 15 to 20 per cent more than would be the case with a casting of ordinary carbon steel.

With the casting in position on the cleaning floor, light the blowpipe and adjust it so that the heating flame will never be oxidizing even when the cutting jet is wide open. A mere feather of acetylene in the heating flame is not objectionable, in fact, it may be of help to the beginner, but a heavily carbonizing flame would be detrimental.

From Fig. 2, it will be evident that the cut is started horizontally across the top surface of the riser and that it progresses downward in a vertical plane from the upper surface of the lower. During the cutting, the blowpipe is moved up and down.

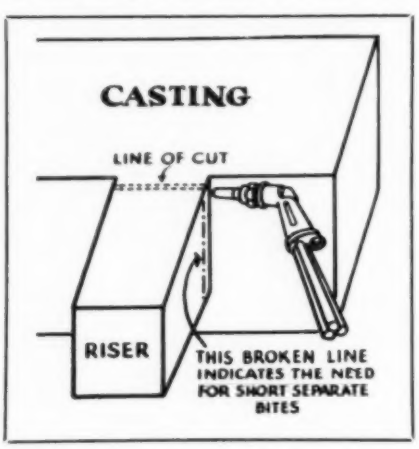


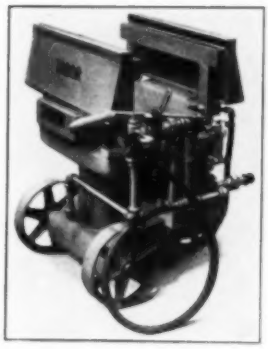
Fig. 2—Sketch showing the recommended position of the blowpipe to the riser

In starting the cut, first preheat the top of the riser across what is going to be the line of cut. It is necessary to do this to establish a straight and easy kerf. If this is not done, there is some chance of the kerf going wild and a pocket forming with the result that through cutting will stop. When the line of cut has been preheated to a dull red, concentrate the preheat at the point where cutting will start. Quickly the spot will become white and start to melt. With the blowpipe tip directed in a horizontal plane across the top, move the blowpipe so that the inner cones of the heating flames are about 3/16-inch away from the face of the riser and turn on the cutting oxygen. If the preheating has been sufficient, the cut will start and it will be possible to look right into the whole of the kerf and watch the progress. The slag will be much more incandescent than in the case with plain steel, and will crackle and spark violently. With the cut properly started, proceed with gentle but speedy up and down motions to carry the cut through the riser.

The noise will resemble that made by the rapid sawing of hard wood. The blowpipe motion must be up and down and not from side to side, otherwise too much time and material will be consumed. It will be observed that the cut is not always sustained at the point directly in front of the blowpipe tip. This is probably due to the fact that the cutting oxygen is still somewhat cool even after passing through the heating flames; and this accounts for the suggestion made to keep the inner cones of the heating flames a short distance from the face of the riser. Do not stop because of this refractory spot as it will be found that this point will be cut as the work progresses. As experi-

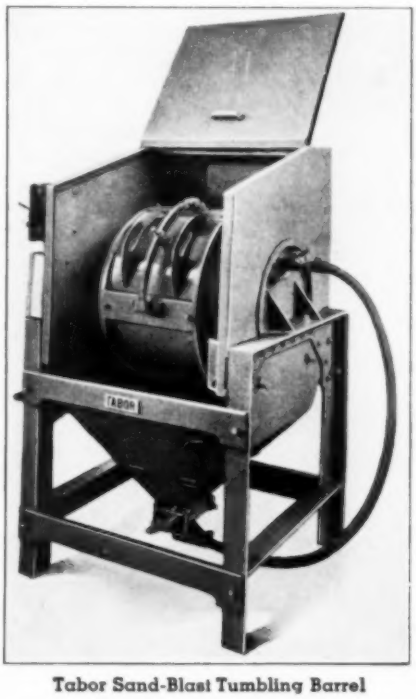
(*Concluded on page* 44)

FIFTY YEARS OF PERFORMANCE
AND CONSISTENTLY ABREAST OF THE TIMES!

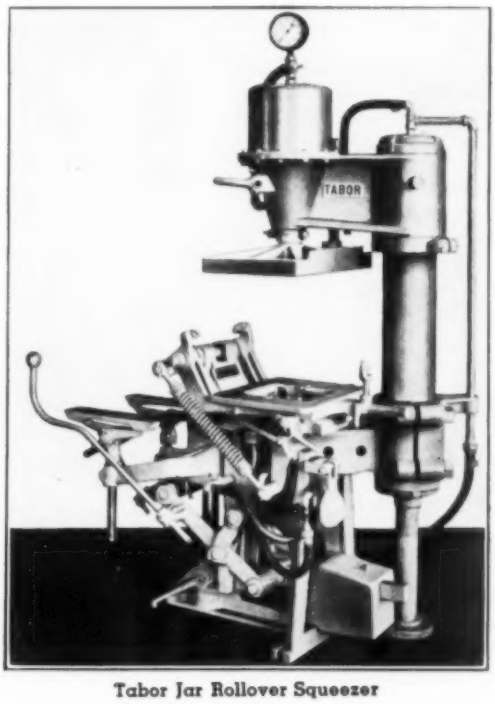


Tabor Portable Jar-Ram
Flask Lift Machine

In marking our fiftieth anniversary, it is pleasant to look back over the years and recall the step-by-step improvements made in molding machines for the benefit of founders. ¶Tabor Machines have persistently maintained their position of leadership in design and construction, keeping ever in step with the advancing needs of foundry practice. ¶Today the Tabor Line provides an ideal machine for any molding job. ¶To round out our ability to meet requirements of the trade, we also manufacture a complete line of Foundry Equipment. ¶We continue to offer to all foundrymen the benefit of our wide experience in solving molding problems.



Tabor Sand-Blast Tumbling Barrel



Tabor Jar Rollover Squeezer

THE TABOR MANUFACTURING CO.
6225 TACONY STREET, PHILADELPHIA, PENNA.

(*Concluded from page 42*)

ence is gained, the distance between the blowpipe tip and the face of the riser will be varied unconsciously to take care of this refractory spot.

If cutting is stopped and the metal cools off below red, it will be found somewhat difficult to restart the cut readily, due undoubtedly to the fact that there is now a surface layer of slag added to the kerf.

In starting an operator out on this work it is advisable, to overcome the psychological factor of "it can't be done," to use a larger cutting nozzle and more oxygen and acetylene than is really necessary. The immediate thing to bear in mind is that it can be done, and once the new operator is over this hurdle, the cutting down of pressures and use of correct nozzle size can and must go forward, because cutting chrome-nickel steel is naturally a somewhat more expensive operation than cutting plain carbon steel.

A skilled operator will sever a 6 x 6-inch chrome-nickel steel riser in 3 to 3½ minutes cutting time which indicates that there is not a great deal of difference in time between ordinary steel riser cutting and the cutting of the chrome-nickel risers once a man has learned the practice. The kerf made in this cutting is about one-third wider than that of carbon steel of same diameter and the cut surface will not be as smooth as in plain carbon steel work, because of hand movement in cutting.

The cut can come within a reasonable distance of the casting proper. Again, though, judgment must be used in the beginning, for it is far better on the first dozen castings cut leave a ½-inch stub for a finish grind than to take off the riser to within ¼ or 3/16-inch and take a chance of spoiling the casting through cutting in. Here again, experience will show the individual how near he can go to the casting.

The cutting of chrome-nickel risers should be done prior to any heat-treatment given the casting.

The suggestions made here should not be taken as inferring that this is the only method and manipulation for this work. They are given because experience has proved that this method does work. Modifications will come to the individual with practice and experience.

Sees Labor Shortage

W. S. Tower, executive secretary, American Iron and Steel institute, New York, recently predicted a shortage of skilled labor in the steel industry if the expected rise in mill operations this spring reaches substantial levels as predicted.

Gray Iron Casting Makes Novel Menu Card

A feature of the recent annual dinner of the London branch, Institute of British Foundrymen, was the attractive menu card presented to each person attending. It comprised a perfect reproduction of an oyster

A strip of paper folded on the inside of the shell contained the menu

shell made of cast iron with a hinge on top. Inside the shell was a folded strip of paper containing the menu, the toast list, and the names of the entertainers. C. H. Kain, Lake & Elliott, Braintree, and president of the London branch, conceived the idea for the menu cards, and the oyster shell castings were made in his firm's foundry. The accompanying illustration shows, the arrangement of the card, and the faithfulness with which this shell is reproduced by casting.

Is Sales Engineer

C. B. Crockett, former secretary, Industrial Truck association, and more recently a partner in the firm of Crockett, Lightner and Smith, New York, has become connected with the Cleveland Tractor Co., Cleveland, as sales engineer. Mr. Crockett is a graduate of Harvard Engineering school, a member of the A.S.M.E. and author of various papers presented before technical organizations and in business papers.

Changes Company Name

Connersville Blower Co. Inc., Connersville, Ind., recently changed its name to the Roots-Connersville Blower Corp. The management of the company will continue with the following officers: L. J. Brown, chairman of the board, J. S. Tatman, president, B. C. O'Brien, first vice president, G. W. Ansted, second vice president, W. E. Newkirk, treasurer, and Emery Huston, secretary. The board of directors consists, in addition to Messrs. Brown, Tatman, O'Brien and Ansted of the following: F. S. Heath, E. D. Johnston, Wayne Stacey, C. A. Thompson and Joseph M. Wilkin.

Book Review

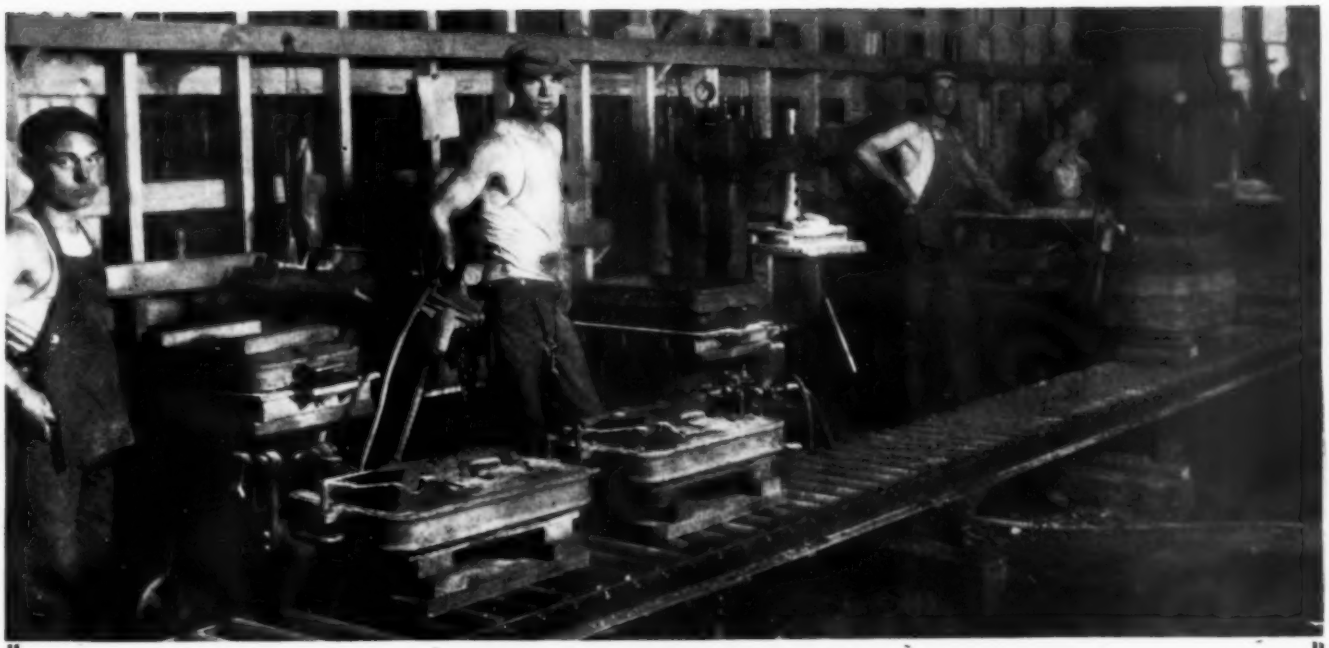
Money and Banking, by William Howard Steiner, cloth, 930 pages, 5½ x 8½ inches, published by Henry Holt & Co., New York, and supplied by THE FOUNDRY, Cleveland, for $4.50 plus 15 cents postage and in Europe by the Penton Publishing Co. Ltd., Caxton House, Westminster, London.

This volume, which should be of great value to the student of money and banking, presents the financial system not as an isolated economic organization, but as an essential part of our general economic system. In describing this inter-relationship the author makes clear how economic life conditions the financial system and how it in turn effects our economic life. He has placed emphasis upon why and wherefore, rather than upon how the institutions of money and banking operate. At the same time he has included sufficient factual and technical data to afford a background for adequate understanding of the problems faced.

Under the headings, namely money and credit, commercial banking, non-commercial banking, the banking system and credit control and prices, the author has revealed an intimate knowledge of our financial system.

Transferred To Texas

T. F. Scannell, formerly St. Louis representative of the Falk Corp., has been appointed representative for that company in Texas and Oklahoma with headquarters at 1410 Magnolia building, Dallas, Tex. Fitch S. Bosworth, 5475 Cabanne avenue, has taken over the representation in the St. Louis territory.



(*Above*) **Type JS**
Jolt Squeezers

Type PK
Jolt, Squeeze Strip Machines

(*Center*) **Type SB 5**
Core Blower

(*Below*) **Type G**
Jar ramming Power turnover foot draw machine,—long model.

We build *61 types* of machines for castings and *14 types* of machines for cores.

INTERNATIONAL
MOLDING MACHINE CO.
2608—2624 W. 16th St.
Chicago, Ill.

Early Malleable Days in Newark

By GARDNER MEEKER

DAVID M. MEEKER, founder of the present Meeker Foundry Co., Newark, N. J., learned the trade of saddler. His hardware was imported from England; probably crucible metal, of good quality.

The success of Seth Boyden in producing malleable iron in the old Barlow plant, southside of Orange Street, Newark, west of the Hewes and Phillips Iron Works, gave David the idea of producing his own castings.

With a partner, he began work in the Hedenberg Works, south of Warren Street, Newark, next to the inclined plane of the Morris Canal. It is probable that their first malleable iron was melted in crucibles, although there was a cupola furnace in the Hedenberg Works, for many years. This business venture failed and Meeker assumed the debts of both partners.

In 1843 the firm of Gardner, Harrison & Co., built the first structures at 95 Clay street, Newark, for the production of malleable, gray iron and composition castings. This firm was composed of Samuel Gardner, Ira Munn Harrison and David M. Meeker, the active working partner. At that time Clay street was a mud lane leading from High street, across Broad to the lumber yards on the Passaic river. Just north of Clay street, Mill brook ran east, into the Passaic river. Broad street and later, Mount Pleasant avenue, crossed the brook on massive red sandstone, single arched bridges. These were in evidence in 1876 but since have been buried under filling. The bed of the brook is occupied by one of the large branches of the Passaic Valley sewer, draining a large part of North Newark. In 1843 and for sometime after, the tumbling barrels or mills were on the north side of Clay street, and foundry refuse was dumped into the brook.

Install Exhaust Mills

These mills were primitive—six cast iron staves, journals on cast iron heads ran in open oak boxes with leather caps, driven by cast iron friction gears. Hard iron stars and scraps of leather were thrown in to scour the castings. With slight modifications in size and details, this method of cleaning was continued up to the installation of exhaust mills made by the W. W. Sly Mfg. Co., Cleveland, about 1900. Very light castings were pickled in dilute sulphuric acid. How the power was applied to these mills on the north side of Clay street, is problematical. Probably by a small upright steam engine. The brook was too small to furnish power.

David M. Meeker assisted by his father-in-law, Samuel H. Gardner soon bought out his partners. He was sole proprietor throughout the Civil war, when, at one time, he paid $60.00 per ton for pig iron. After the panic of 1873 and the subsequent depression he took in his son, Stephen J. and the firm became David M. Meeker & Son, until his death in 1880, when his son became sole owner.

The composition business never amounted to much, but fine gray iron castings were made until 1905, when it was decided to produce only malleable castings. All the malleable castings made at 95 Clay street, were cupola melted until an air furnace was installed in the winter of 1886.

Used Charcoal Iron

Cupola melted iron was subject to trouble caused by sulphur taken up from its direct contact with the fuel. Excessively fluid metal could be obtained but too much sulphur made it difficult or impossible to anneal. This trouble frequently occurred and David M. Meeker constantly kept on hand a carload or two of charcoal pig iron. The low sulphur content of this metal would correct the sulphur in the mixture and very good malleable iron would be produced.

A small show case containing samples of this metal was in existence for many years and was awarded a medal at the New Jersey State fair. The medal now is in possession of the Meeker Foundry Co.

These samples would compare favorably in finish and strength with the best small malleable castings of today. They could be drawn out cold on an anvil, and could be welded like wrought iron in a forge. Little was then known of the chemical composition of cast iron or the pig iron from which it was produced. All grading was done by the appearance of the fracture of the pigs.

Charcoal pig iron was so potent a medicine for sick metal that its identity was kept a profound secret. Always it was referred to as *oxybodel*. Later, when trouble was encountered with *high* heats in air furnace melting, the ferrosilicon, ferromanganese, etc., used to correct the trouble, was given the same name, but this soon was dropped and the name *nigger* (common to most malleable plants) used instead.

After David M. Meeker's first success in producing malleable iron commercially at 95 Clay street, the Terry Brothers, Terryville, Conn. commissioned him to design and build their first foundry. This firm has always produced the finest of small malleable castings.

The cupola still in existence, back of No. 95 Clay street, was installed by the predecessors of the Isbell-Porter Co., Newark, and is one of the oldest in the state. It is of the Mackenzie type oval instead of round with annular tuyere and has been used to produce both gray and malleable iron. Sometimes frequent alternation necessitated the use of fluorspar as a flux to cleanse the fire brick lining from all impurities.

(*Concluded on page* 48)

Adopt Air Furnace

DIRECT descendants of the man who commenced malleable iron castings in Newark, N. J., almost 90 years ago still are in active control of the business which is conducted along modern up to date lines in a plant occupying the site of the first modest establishment. Tradition and a wealth of memories hover over a plant which has been in operation practically throughout the entire life of the malleable foundry industry in this country. Every worth while improvement has been investigated as it appeared, and if found worthy, has been adopted. The cupola was replaced by one of the first air furnaces and tumbling barrels equipped with dust exhausters were installed over 30 years ago. Outside one unfortunate experience where extra capacity suggested the advisability of making heavy castings, the foundry has been devoted exclusively to the production of light castings.

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HERMAN MOLDING MACHINES

RAILROAD EQUIPMENT

Job: Side Frame

Production: 370 molds per day for two nine-hour shifts or 185 molds per shift. This is average daily production for one month. Largest number of molds produced in one shift is 210. Flasks are approximately 3 ft. x 9′ ft. x 1½ ft.

Machines: 1—Herman Jarr-Rollover for drags.
1—Herman Jarr-Rollover for Copes.

Crew: 2 men on each machine.

Comparable records are being made on bolsters, yokes, center fillers, wheels, and other car castings. Hermans are also being used extensively for making cores.

Now is the time to install machines or replace those obsoleted ones in your foundry. Equip to obtain that desired production at lowered costs.

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Gibson Battle & Co., Limited, Sydney, N. S. W.

(*Concluded from page 46*)

From 1876 until the production of gray iron was discontinued this cupola was used for gray iron alone. A malleable shop was erected southwest of the Clay street buildings and west of present sorting room which was then an open yard. A new cupola was placed at the east side of this new building and its location still can be traced in the roof and floors. This was also a Mackenzie cupola, but with circular instead of oval section.

No record of the original annealing furnace is available but undoubtedly it was anthracite fired from four or more small fire boxes. This type persisted until the introduction of oil, with two pressure burners in the rear wall installed about 1895. These proved expensive and complicated. Underfeed stokers burning soft coal were tried about 1900. These proved vulnerable to tampering and neglect and were replaced about 1910 by the present system.

Mill Scale for Packing

Annealing pots and trucks changed little from the first, until power driven trucks were invented. Mill scale always was used as packing and whenever possible it was procured from *wrought iron* mills. It was considered essential to charge the old packing at frequent intervals, with new scale and ammonia. This practice since has been laughed out of court but it is a well known fact that in the old days, fused packing, scaly castings, etc., practically were unknown. Probably the quality and uniformity of the fuel and pig iron as well as the lack of danger of forcing any part of the process with the hand fired, natural-draught methods accounted for the immunity.

At first all molds were made on the bench, with hand rammers, slickers and rapping bars. Tradition of hand-craftsmanship, developed from this practice has been carried on until the present. The first squeezers were installed about 1880. The small machine some of which are still in use, were made by the Adams Co., Dubuque, Ia., for the Meeker Co. from its own specifications.

Core making practice differed but slightly from that of other foundries. Efficiency in the material used for binder was looked for rather than economy. Rosin was used in all small cores. Pure corn oil at one time was used successfully.

Manual skill and the search for quality—two things from which the business grew—had a notable development in the pattern shop. Each gate of patterns constitutes an individual problem which can not be solved by mass production methods. The skill of David M. Meeker, who did most of his own first pattern work is recalled in the work of the pattern shop today. After David M. Meeker it is noteworthy that there have been only four presiding geniuses in the pattern shop since the early days.

Land extending to Spring street was purchased west of the malleable foundry and in the winter of 1886 the first air furnace was built for S. J. Meeker by Benjamin J. Walker, Erie, Pa. This furnace pointed north and south on the north side of No. 1 stack first built 110 feet high and later reduced to 90 feet. It was a success from the start, and was the first or at least one of the first malleable iron air furnaces built in this country. Air furnaces had been used in cast iron foundry practice before that date. In the first heat from this furnace an incident which might have been serious, deserves recording. The furnace men had coated the skim-irons with fire clay but had not dried them. When placed in the bath to start skimming an explosion occurred and small drops of molten iron were blown from the skim-door. These missed the furnace man but struck B. J. Walker full in the face. His eyebrows, lashes, mustache and hair below his hat were obliterated and his suit of clothes riddled. He suffered no other harm.

The success of air furnace iron increased the business. About 1898, No. 2 furnace and stack were built and No. 1 furnace was rebuilt east and west. Increase of productive capacity brought about a search for greater tonnage. This led to an unfortunate experience with a certain railroad car coupler, and other evil effects which can be seen until this day. The coupler was the best of its kind as can be seen from the fact that its two vital principles,—double lock and pin behind knuckle—are found in every freight car coupler today. However the Meeker foundry was not adapted to handling 150-pound malleable castings. In the attempt to do so, and at the same time produce high grade small malleable castings, all the equipment and layout of the plant were thrown out of proportion and distorted. As a result of that lesson only eight malleable iron castings have been handled on a production basis for the past 30 years.

Book Review

Handbook of Chemistry and Physics, edited by Charles D. Hodgman, imitation leather, 1818 pages 4¼ x 6½ inches, published by the Chemical Rubber Publishing Co., Cleveland, and supplied by THE FOUNDRY, Cleveland, for $6.00 plus 15 cents postage and in Europe by the Penton Publishing Co. Ltd., Caxton House, Westminster, London.

Most important revisions in this work, which represents the 18th edition in a period of 20 years, pertain to the table of physical constants of inorganic compounds, which has been enlarged by nearly a thousand compounds. The metal-organic compounds, considerably increased, have been placed in a table following the physical constants and inorganic compounds. Numerous other important revisions have been included.

This complete text has 220 pages of mathematical tables and formulas, 800 pages of chemical tables, 44 pages on the properties of matter, 135 pages on heat, 54 pages on sound, electricity and magnetism, 204 pages on light, 134 pages of measures and units, and other tables and information to scientific workers.

Talks on Sand Control

L. B. Knight, sales manager, National Engineering Co., Chicago, addresed the members of the Northern Illinois Foundrymen's association at a meeting at the Hotel Freeport, Freeport, Ill., Jan. 16, on "Sand Conditions and Sand Control."

Forms New Company

Bristol Co., Waterbury, Conn., recently has incorporated a separate company, the Bristol Co. of Canada, Ltd. Factory and general headquarters will be located at 64 Princess street, Toronto, Ont.

Is Made Vice President

Carl O. Anderson, formerly with Leeds & Northrup Co., Philadelphia, and more recently with the Claud S. Gordon Co., Chicago, has been elected vice president and appointed general manager of the Pyrometer Service & Supply Co., Cleveland, a subsidiary of the Gordon company.

Announces Meeting

Annual meeting of the American Society for Metals, formerly the A.S.S.T., will be held in Commerce hall, Port of Authority building, New York, Oct. 1-5.

Committee on industrial gas research of the American Gas association recently has published two bulletins covering two programs devoted to improvements in the application of gas for industrial heating purposes. Report No. 723 covers "Research in Fundamentals of Combustion. Space Requirements in High Temperature Gas Furnaces," and report No. 724 "Research in the Elimination of Noise in Industrial Gas Burners." The work was carried out at the testing laboratory of the association, 1032 East 62nd street, Cleveland.

FOUNDRY EQUIPMENT

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FORCED to shovel endless tons of sand, the efficiency of the molder and his skill both suffer . . . Production schedules become erratic, quality uncertain.

Bartlett-Snow sand handling and sand conditioning equipment is the proven, time tested answer to this age old problem. Recovered from the knockout floor, then screened, blended, tempered to exact requirements . . . the sand is dropped into the flasks from hoppers overhead . . . production costs are cut, rejections lowered, competitive conditions met . . . Expenditures for equipment need not be large. Frequently a modest installation makes tremendous savings.

Our engineers, experts who have made thousands of successful installations, will gladly visit your plant, study your costs, your methods . . . Their recommendations furnished with definite guarantees of performance will help you solve your problems. If you prefer, send for Bulletin 63. It describes the savings that can be made when skillful hands are saved for work where skill is needed.

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Headed for a fate worse than death!

The Adventures of Bill

BY PAT DWYER

A RECENT local cat show may have been responsible, or perhaps the melancholy wailing of a cat in the yard prompted Bill to break a prolonged silence as we sat smoking peaceably in front of an open fire. Personally I rather lean to the second hypothesis. The howler apparently had the *vox humana* stop pulled out to the limit and the dismal, penetrating yee-au-au-ah-ah-ow-ow mating call rivaled the blasts of the fog horn at the harbor mouth in regularity. At the moment I can think of no fitting comparison in intensity, except perhaps it might be a 6-foot saw screaming through a tough oak log.

"Do you remember," Bill inquired, "a list I showed you a few months ago of molder's excuses for defective castings?"

"No," I lied cheerfully, just to aggravate him.

"I did not expect you would. A vacant mind gathers no moss, or, something like that. You know what I mean. Well, any way the list contained an item: Cat walked across mold. The other day I had a letter from a prominent foundryman in the East claiming that cat walking in his foundry has developed into quite a nuisance. Listen here a minute and I'll read you his exact words:

A considerable number of our green sand molds are left open over night and we are being troubled with cats and dogs destroying them. We are wondering if you can suggest any method of ridding the foundry of cats.

"A rather peculiar problem," I admitted. "Many odd and catty corner angles. What did you tell him?"

"Well," said Bill, "I'll tell you. Realizing the gravity of the situation and the necessity for immediate and drastic action I was minded at first to suggest the hiring of a professional gun man armed with what members of the fraternity are pleased to designate in their jocose fashion as a rod, or, a crew of these gentlemen equipped en masse with a machine gun, or individually with their favorite fruit, pineapples in assorted sizes.

"However, a few moments reflection showed me that this idea no longer is tenable. Under the revised code recently adopted by the Underworld Bumpers association I find that the main activities of the association are confined to the extermination of rats, with occasional forays into the haunts of bulls, bears, high jackers, rum runners and other varieties of the larger carnivora and predatory family. No mention is made of *felis domestica*—pussy to you—and I am afraid that any incursion into that field would be considered as unfair competition by United Furriers, Amalgamated Restaurants and possibly other interests specializing in cats on and off the hoof."

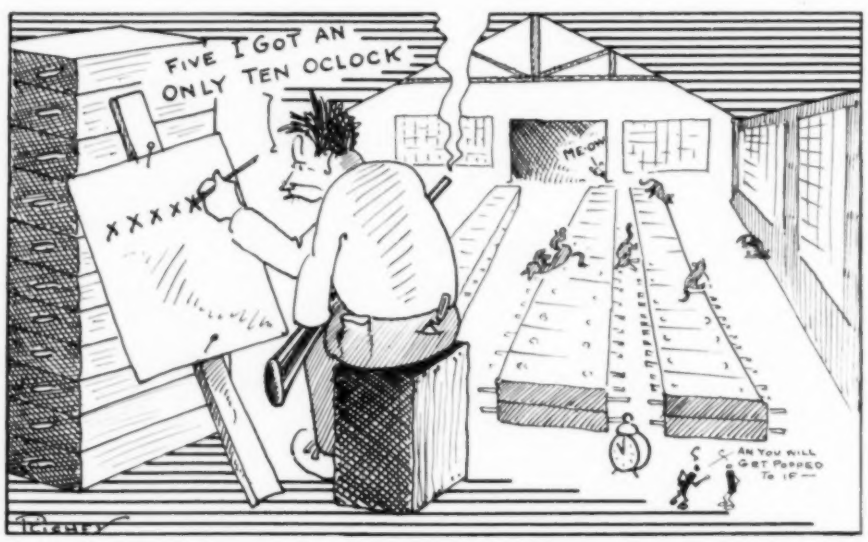
"All right," I said. "The code also probably excludes cat birds, cat boats, cat briers, cat calls, cat-o'nine-tails, let the old cat die and a cat may look at a king. So what?"

"Exactly." Bill beamed his appreciation of this rather neat flight of alliteration, "I guess you got 'em all in, except possibly some of the first cousins, catacomb, catafalque, catalan, catamount, catapult, cataract, catarrh and catastrophe. You may have heard of a game known as tip cat—"

"Why—ah—yes indeed! While on the subject of animal games, I trust you will pardon me for mentioning the fact that I also am familiar with the game known as passing the buck."

"O.K. Davy Crockett." Bill elevated both hands in a mock gesture of surrender. "Take that there weepin' f'om yo' shouldeh. Don't shoot. Ah'll come down.

"I wrote the citizen to the effect that offhand I should be inclined to say that a little .22 rifle or air gun in the hands of a skilled and more than willing apprentice would prove the easiest and quickest way out of the difficulty. A small portion of cat meat judiciously sprinkled with strychnine and temptingly displayed at or near one of the favorite cat walks or promenades would do the trick. The same might be said of a fox trap or a wire snare attached to a powerful spring and dangled over one of the openings through which the feline marauders slink into and out of the shop. If he happens to have a skilled ball player among the employes, a small bounty per pair of cat ears might tempt the ball tosser to put the cats *hors de combat* with a well di-



Figuring 9 lives per cat the revised score will read 45 points

rected shower of brickbats, paving stones or core butts.

"The foregoing measures you will note are based on the assumption that the cats are outlaws, dangerous carnivora, vermin, and therefore not entitled to the protection of the game laws of the sovereign state in which the foundry is located. Possibly I am mistaken. A more careful re-reading of the letter leads me to pause. He writes: 'We are wondering if you can suggest any method for ridding the foundry of cats.'

"That word *ridding* may be construed in two ways. The first is that he wishes to get rid of the pests irrespective of method or after condition. The second is that he merely desires a cat free foundry. This does not necessarily imply a flock of dead cats. Conceivably he shudders at the prospect of depriving even a single cat of its nine lives. Burying the bodies in a floor largely devoted to open sand molding not only represents a waste of time that might be devoted to the master's interest, but also might prove a source of embarrassment a few days later when a molder digging a hole in the floor sinks his shovel through the mortified remains of what had been a champion midnight yowler.

"Proceeding therefore on the second or more humane assumption that he merely wants to banish the present flock of cats from the premises I wrote that I had pleasure in directing his attention to the virtues of an humble herb, one of the great family of nature's remedies herbs, roots and berries, gums, barks and balsams prepared by the hand of the omnipotent Creator himself for the amelioration of the ills that beset mankind.

"This little herb, ladies and gentlemen which I now hold as you see between the index finger and thumb of the right hand is known in Materia Medica as *nepeta cataria*, to the vulgar in these United States as catnip, and to their prototypes in the British Isles as catmint. For some hitherto unexplained reason, cats show a passionate affinity for this herb. With a bunch in one hand a man could lure a cat or a bunch of cats as readily as the Pied Piper lured both the rats and the children out of the ancient town of Hamlin over the hills and far away.

"I suggested he should buy a handful at the nearest drug store. Place it on an open space on the floor. When the cats inevitably snoop around to take a snifter, drop a net over them and then dispose of them afterward as his conscience might dictate.

"The dog question requires a different approach. Cats can and have been known to materialize in foundries protected by fences and concrete walls. One theory is that they develop from seeds in the new sand, but this point still is in the debatable stage. However, an opening in the window, door, or wall is essential to the presence of a dog in the foundry. Obviously the only preventative measures required is to seal all unnecessary openings.

"Another inquiry from a different section of the country deals with a somewhat controversial subject, classification of railroad scrap. The writer stated that his understanding of the

Natty Bumpo rebukes the tempter

term always has been that No. 1 scrap, either machinery or railroad, is scrap that does not contain hard iron and is suitable for ordinary purposes in gray iron foundry practice. He would appreciate an opinion on the subject.

"I told him that in the meaning of the term No. 1 railroad scrap my opinion coincided with his. This opinion also is held in a general way by all practical operating gray iron foundrymen. The term covers all gray iron scrap resulting from railroad operation and maintenance broken to cupola size, reasonably free from oxidation and containing approximately 2 to 2.50 per cent silicon. For special purposes brakeshoes and car wheels are classified as No. 1 railroad scrap. Although the silicon content of these two classes of castings is considerably lower than that in other varieties of railroad scrap, the physical properties of the iron are excellent, and under certain conditions meet the foundryman's requirements more adequately than irons with higher silicon content.

"Under a legal technicality a seller possibly might deliver an entire consignment of car wheel scrap to a customer who specified No. 1 railroad scrap, a consignment totally unsuitable to a foundryman engaged in the production of thin castings. Conceivably also a seller might supply an entire lot of miscellaneous 2 to 2.50 per cent silicon scrap to a man engaged in the production of dense or hard castings. However, the possibility is remote where buyer and seller are on fairly intimate terms, or where the buyer distinctly specifies what proportion—if any—of the shipment may be made up of brakeshoes or car wheels.

"Owing to its many ramifications, the classification of scrap up to the present has not been reduced to universally acknowledged standard specifications. Many years ago the American Foundrymen's association started a movement in that direction with 18 classifications for cast iron scrap. Under this classification No. 1 machinery scrap was described as: Cast iron scrap of first quality which possesses evidence of having been machined, such as planed, or turned surfaces, bored or drilled holes, etc. It must be cupola size, no piece to weigh more than 100 pounds, and must not exceed 24 inches in length or width. It shall be classified as follows: No. 1. Heavy pieces greater than 1-inch in section. No. 1 medium pieces ½-inch and not to exceed 1-inch in section. No. 1 light, pieces not to exceed ½-inch in section. Scrap classed as railroad scrap or under any other classification of these specifications, and burned iron of every description will not be accepted.

"Manifestly a great volume of railroad scrap would come under the foregoing classification. The fact that the original casting served in the transportation industry was held, and quite properly held, to have no bearing on its ultimate classification.

"After disposing of nearly all gray iron scrap under various classifications the specifications list railroad scrap under six headings: No. 1 railroad scrap chilled cast iron car wheels. No. 2—miscellaneous car wheels. No. 3, plain gray iron brakeshoes. No. 4, steel back and insert brakeshoes. No. 5, burned iron. No. 6, unburned grate bars, grate bar rests, and journal boxes with steel parts removed.

"Incidentally it is interesting to note that the last item now is practically extinct. Journal boxes mostly are malleable iron or cast steel. Which shows that in drawing up specifications and classifications, provision should be made for changes in the future.

"According to Ferrous Scrap Metal Specifications in *Foundrymens Handbook*, abstracted from Bulletin R58-28, bureau of standards, division of simplified practice, no separate classification as a whole is made of railroad scrap. Car wheels and brake shoes are given separate classifications. Apparently all other forms of gray iron scrap may be listed under No. 1 machinery cupola scrap, no piece over 24 x 30 inches and 150 pounds; No. 1 machinery breakable scrap, pieces over 150 pounds which may be broken readily under an ordinary drop; No. 1 standard cupola scrap, miscellaneous casting scrap free from stoveplate and agricultural scrap; No. 1 standard breakable scrap, miscellaneous scrap over 150 pounds which readily may be broken under the drop to cupola size.

Uses Recuperator on Air Furnace

(*Continued from page* 11)

ator. As shown in Fig. 1, the insulated duct leading from the recuperator to the fan is so arranged as to permit the operation of the overhead crane over the furnace.

The recuperator, which was supplied by the Carborundum Co., refractory division, Perth Amboy, N. J., consists of rows of horizontal silicon carbide refractory tubes supported at either end in terminal walls of fireclay. Air to be heated is drawn through the tubes and the combustion gases pass around them. Forty-five tubes are employed in this installation. Fireclay corebusters are centered in the tubes to keep the air in contact with the walls of the tubes.

Elevating the recuperator provides a vertical leg in the stack and a horizontal flue below the recuperator so that most of the ash settles in these passages. Any ash carried over into the recuperator is chilled rapidly and becomes light and fluffy. A small amount deposits in the recuperator, but the bulk passes out the stack suspended in the gases. The deposit on the recuperator tubes is brushed or blown away during the daily melting operation, using openings provided for the purpose. The cleaning process requires approximately 15 minutes a day.

Air Temperature Varies

The final preheated air temperature attained during the run varies with the duration of the heat and amount of heat storage in the furnace and recuperator. In general on small heats of 17½ tons twice a week (7 to 7½ hours for a complete cycle) a final air temperature of 500 to 550 degrees Fahr. is attained, on larger heats 600 to 700 degrees Fahr. As an example of the higher range a 28-ton heat fired 9 hours 40 minutes to tapping with 50 minutes to pour the heat, showed air temperature of 680 degrees Fahr. All temperatures given were taken at the blower inlet. Temperatures are approximately 75 degrees higher at the recuperator outlet, the difference representing the loss in the duct.

Temperatures in the blower and burner lines are reduced approximately 150 degrees due to mixing the air with the coal. However, this is not a heat loss for the temperature of the coal is raised. A heat made in a cold furnace shows preheated air temperatures averaging 60 degrees less than when the furnace was in operation the previous day, thus indicating the importance of heat storage in the furnace and recuperator. Data collected from a specific run shows the rapidity with which appreciable preheat is obtained. After being under fire 1½ hours, the air temperature at the blower was 200 degrees and the waste gas temperature at the recuperator base was 1200 degrees. At 2 hours the temperatures were 300 and 1900 degrees respectively, at 3 hours 400 and 2490 degrees and at 4 hours 450 and 2550 degrees. After 4 hours the waste gas temperature at the recuperator base remains practically constant and air temperatures rise gradually to the figures previously given.

Several Advantages Result

Several advantages have resulted from the installation of this equipment. An average fuel saving of 22 per cent has resulted through the application of the recuperator to the melting problem. On daily operation this figure would be bettered considerably, and with large heats, even with low production, the fuel ratios would be improved considerably.

In general the time required to bring the heat to pouring has been reduced about 10 per cent. The company also reports that the characteristics of metal tapped from the recuperator equipped furnace are known to be improved, although that factor has not been evaluated definitely as yet. The hotter flame and shorter exposure of the metal to the flame apparently is producing less oxidization. The reduced fuel consumption reduces the amount of sulphur introduced into the furnace, resulting in less contamination of the metal.

Brass and Bronze Castings Are Discussed

Wayne Cockrell, metallurgist, Burgess-Parr Co., Moline, Ill., and Herman Alex, foundry superintendent, Rock Island Arsenal, Rock Island, Ill., were speakers at the meeting of the Quad-City Founderymen's association, Jan. 15 at the LeClaire hotel, Moline, Ill. Mr. Cockrell spoke on "Illium" explaining its composition, uses of the alloy, process of melting and molding, and properties which make the alloy desirable for certain uses in the casting field.

Mr. Alex, in discussing "Castings of Brass and Bronze," told of the classes in which metals of that type should be placed according to mixtures and discussed methods of melting, range of temperatures, and pouring. The speaker also compared molding of brass and bronze with that of iron and presented data on the properties of some types of nonferrous castings.

Harry F. Henninger, International Harvester Co., Rock Island, Ill., president of the Quad-City Foundrymen's association, presided. The next meeting will be held at the Fort Armstrong hotel, Rock Island, Ill., Feb. 19, and will be devoted to a talk by George Evans, Mathieson Alkali Works, New York, on "Desulphurizing of Cast Iron."

Book Review

Materials Testing in the Iron and Steel Foundry (Werkstoffpruefung in der Eisen-und Stahlgiesserei), by G. Tschorn, paper, 196 pages, 6¼ x 9¼ inches, published by Wilhelm Knapp, Halle (Saale), Germany, and supplied by THE FOUNDRY, Cleveland, and in Europe by the Penton Publishing Co. Ltd., Caxton House, Westminster, London.

This volume which is part 19 of a series on works practice in the iron, steel and metal foundries, and edited by Hubert Hermanns, describes chemical and physical testing of the raw and finished materials in iron and steel foundries. The book is divided into six chapters of which the introduction describes the purpose, aim and goal of works testing. Chapter two deals with the plan and apparatus of a testing laboratory while chapter three discusses the organization of testing methods in the foundry.

Chapter four deals with test specimens and the fifth chapter gives details of testing procedures including chemical analyses of iron and steel castings, fuels, slags, limestones, dolomite, fluorspar, refractories; physical testing of iron and steel castings including hardness, strength, dynamic, specific gravity, magnetic and x-ray testing methods; and metallographic testing is discussed from the theoretical and practical applications. The final chapter is an appendix giving various chemical and other information.

Plan Conference

The International Bureau for Technical Education, with headquarters in Paris, is arranging a conference to be held in Barcelona, Spain, May 17-19. Questions of technical instruction, vocational direction, apprenticeship and unemployment will be covered.

Appointed Representative

F. M. McCarthy, Columbus, O., has been appointed foundry representative for the state by the Ironton Fire Brick Co., Ironton, O.

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Polishing Cast Iron Specimens

(*Concluded from page* 14)

hole is larger, but the size of the flake remains constant. The specimen was etched an additional minute and the appearance is shown in Fig. 13.

By this time a sizeable hole had been dug by the acid and the graphite was beginning to crumble due to the oxidizing properties of the nitric acid, but still the flake retained its original size. Finally, the specimen was etched for five minutes and then examined. It was necessary at this stage to focus individually on the flake of graphite, standing up from the surrounding ferrite, and on the edge of the large hole etched in the iron. Fig. 14, the graphite, is the same size as when first examined, although considerably crumbled. Fig. 15 shows the edge of the hole in the ferrite.

Reveals True Size

The foregoing bears out the claim that at 100X it would be impossible to distinguish between the hole itself and the graphite and hence incorrect conclusions might be drawn. The new method of polishing when done correctly reveals the true size of the graphite flakes in cast iron without smearing ferrite over them.

In connection with this method of polishing, a need is growing for some method of classifying the size of the graphite particles. Metallurgists and foundrymen who, have been looking for the past 20 or 30 years, at the type of micrographs shown in Fig. 1 and have classified graphite accordingly, now are called upon to look at something entirely different and decide whether the graphite flakes are fine or coarse without any adequate means of comparison. The accompanying set of five micrographs, Figs. 16, 17, 18, 19, 20, was made to determine whether the graphite flakes in a specimen of iron were fine or coarse. Obviously this classification will not be final.

All that the author hopes for in this series is to show the need for some accurate classification of graphite and to give a working chart until a better one can be devised. All these micrographs were made at 500X because at 100X it is impossible to distinguish accurately between the various sizes of the flakes. The classifications can be made quickly and easily at 500X.

Fig. 16 shows graphite which may be classified as very coarse, or number 1 on this scale. Fig. 17 is coarse graphite, or number 2. Fig. 18 shows medium sized graphite, or number 3. Fig. 19 hows fine graphite, or number 4. Fig. 20 shows very fine graphite, or number 5

In making this classification, no attention was paid to composition of the iron, manner of making or casting, nor amount of free graphite present in the specimen. Nothing but the size of the graphite particles was considered. It might be well to consider these items in a further study of the subject.

The series of micrographs can be used only for the ordinary gray cast iron where the graphite is in flakes, and not for the high test and malleable irons where the graphite has been *balled up*. A number of other interesting features might be included in a further study of graphite in cast iron. For instance, what is the true shape of the graphite particles as a whole—are they plates, flakes, or do they occur as threads? Is the graphite in various irons always of the same density or is some graphite more porous due to differences in the manner of casting the iron? These are but two of the interesting questions which suggest themselves.

The series of micrographs showing the varying sizes of graphite flakes will be of some aid to puzzled metallographers and foundrymen who find they must begin to classify graphite in cast iron all over again. Also the series may impress upon them the necessity for making an exhaustive study of the subject.

Polish Specimens

INVESTIGATION into the methods and equipment employed for polishing specimens of cast iron for laboratory examination disclosed the fact that under certain conditions the graphite flakes are dragged out of the matrix and that what the examiner has been led to believe is a graphite flake really is the cavity from which the flake was lifted. In the new method a velvet wheel is employed. The mat is removed with a scraper and then the wheel is moistened with water to retain a little jeweler's rouge. The paper dealing with his work and the results was prepared by Eugene W. Nelson and presented by L. A. Danse, Cadillac Motor Car Co., Detroit, before the 1933 short foundry course at Michigan State College of Agriculture and Applied Science, Lansing, Mich.

Ohio Ferro-Alloys Corp., Canton, O., has taken new offices in Chicago at 1426 Conway building. L. F. Johnson, who has been in charge of sales in Chicago since 1931, will continue in that capacity, handling sales of the company's products, including ferrochrome, ferrosilicon, silicomanganese and ferromanganese.

A. S. M. E. Section Plans Birmingham Meet

Birmingham section of the American Society of Mechanical Engineers, with the American Foundrymen's association co-operating will hold a foundry practice meeting in Birmingham, Ala., Feb. 19 and 20. A technical session and visits to numerous plants in the Birmingham industrial area will feature the meeting. Headquarters will be maintained in the Tutwiler hotel.

The following program has been arranged:

Monday, Feb. 19, 1934

9:00 a.m. Registration

12:00 noon Luncheon at one of Birmingham plants.

1:00 p.m. Plant visitations.

8:00 p.m. Open house at Tutwiler hotel.

Tuesday, Feb. 20, 1934

9:00 a.m. Plant visitations.

12:30 p.m. Luncheon at Tutwiler hotel.

2:30 p.m. Technical session:

Papers: "Dust Abatement in the Foundry with Special Reference to Certain Engineering Aspects," by E. O. Jones, National Founders' association, Chicago.

"Developments in Castings' Applications Through Use of Alloys," by E. K. Smith, Electro-Metallurgical Co., Chicago.

Discussions

5:00 p.m. Adjournment.

6:30 p.m. Banquet at Tutwiler hotel.

John M. Gilfillan is chairman and John A. Sirnit is chairman of the program committee of the Birmingham section.

Heads American Engineering Council

John F. Coleman, consulting engineer, New Orleans, past president of the American Society of Civil Engineers, was elected president and Frederick M. Feiker, formerly director of the bureau of foreign and domestic commerce, was appointed executive secretary of the American Engineering council at its annual meeting in Washington, Jan. 11-13. Lawrence W. Wallace, formerly executive secretary, resigned to become vice president of the W. S. Lee Engineering Corp.

Sterling Wheelbarrow Co., Milwaukee, reports the demand for foundry flasks tending upward.

ADVERTISING PAGES REMOVED

Copper in Gray Cast Iron

(*Concluded from page* 15)

nation with nickel and chromium on the properties of cast iron, and to comparing copper cast iron with the other alloys. Both cupola and crucible heats were run, although a standard cupola was used for the greater part of the work.

Charges consisted of pig iron foundry scrap and steel. Alloy additions were made in the ladle in the form of shot, turnings, or ferroalloys. In some of the heats, the copper was added in the molten state. Precautions were adopted to insure homogeneous melts and complete dissolution of the copper inasmuch as failure to do so led to irregularities in the early work.

Arbitration bars and step bars were cast from all heats. Effects on chilling were observed from the character and fracture of the step bars, while the compressive, tensile, and transverse strengths were obtained from tests made on the arbitration bars. The brinell hardness of irons of all compositions was determined.

Work to date on the use of copper in various commercial castings, because of the decided improvements in the properties and the possibility of controlling them, has been sufficiently encouraging to cause the extension of the research project. As one development a cupola with a capacity of 1000 pounds per hour has been constructed and is operating satisfactorily.

Effects of copper with nickel and with chromium are under investigation, and the importance of the copper-silicon ratio is being studied. The present research also includes a study of various methods of introducing copper into the iron. Coefficients of expansion of the various alloys are being determined and the properties at elevated temperatures will be investigated. A detailed report on the work completed to date is now in preparation.

Book Review

A.S.T.M. Standards, in two volumes, cloth, Part I, 1000 pages and Part II, 1300 pages, 6 x 9 inches, published by the American Society for Testing Materials, Philadelphia, and supplied by THE FOUNDRY, Cleveland, for $7.50 for each volume plus 15 cents postage, or $14.00 for both volumes; and in Europe by the Penton Publishing Co. Ltd., Caxton House, Westminster, London.

This triennial publication contains all of the standard specifications, methods of tests, recommended practices and definitions formerly adopted by the society. Part I, devoted to metals, contains 185 standards, of which 104 cover ferrous metals including steel, malleable and gray iron castings; steel; wrought iron; pig iron; and ferroalloys. Seventy relate to nonferrous metals including castings; aluminum and magnesium alloys; copper and copper alloys; lead; nickel; zinc; bearing metals; solder metal; deoxidizers; and electrical heating and electrical resistance alloys. Eleven standards involve metallography and general testing. Part I contains a number of new standards which were adopted during 1933, including austenitic manganese steel castings.

Standards of special interest to the iron and steel industry in the nonmetallic section, Part II, include the following: Cement; refractories and fire brick; coal and coke; naval stores; lubricants; waterproofing materials; electrical insulating materials; shellac; etc.

In both parts of the book, the specifications for a particular class of material are given first, followed directly by the test methods, definitions, etc. A complete subject index is included in which each standard is indexed under the principal subject covered, keywords being given in alphabetical sequence. This index, together with two tables of contents, one listing standards by the materials covered, the other in order of numeric sequence of the designations greatly facilitates the use of the book.

New England Founders Elect Officers

Fred D. Shaw, Walker-Pratt Mfg. Co., Watertown, Mass., was elected president of the New England Foundrymen's association at its 38th anniversary meeting, Jan. 10. Other officers elected are George W. Thornburg, Crescent Park Brass Foundry, Waltham, Mass., vice president; Arthur Gibby, Gibby Foundry Co., East Boston, treasurer, and Fred F. Stockwell, Barbour-Stockwell Co., Cambridge, Mass., secretary.

The executive committee is as follows: Alexander S. Wright, Hunt-Spiller Mfg. Corp., Boston; Walter Saunders, Jr. Providence, R. I.; Thomas Curtin, Waltham Foundry Co., Waltham, Mass.; George F. Hutchins, Standard Foundry Co., Worcester, Mass., and Charles A. Reed, Rogers-Brown-Lavine Co., Cambridge, Mass. Retiring president Albert Sweet, Milford Iron Foundry, Milford, Mass., presided.

A brief letter of condolence, signed by the 69 members attending, was sent to Secretary Fred F. Stockwell, who was unable to attend because of illness. Following the business session and election, an entertainment was furnished by a committee of which C. A. Reed was chairman.

Secondary Metals Industry Code Approved

Code of fair competition for the brass and bronze ingot industry engaged in the smelting and refining of secondary metals into brass and bronze alloys in ingot form was signed Dec. 21 and became effective Jan. 2. At a meeting of the entire industry in Cleveland on Jan. 4 and 5, the following were elected to serve as industry members of the code authority: George H. Bangs, L. Chapman, I. Glueck, R. C. McElroy and Clarence B. White. Mr. Glueck was chosen as chairman of the code authority and Mr. White elected vice-chairman. R. D. T. Hollowell, 308 West Washington street, Chicago, was elected secretary-treasurer of the code authority.

To Hold Conference

In accordance with a resolution adopted at Stockholm in 1930, the Fourth International Congress for Applied Mechanics will be held in Cambridge, England, July 3-9. Subjects to be discussed will be grouped under the following four headings: Rational mechanics, including vibrations of structures and machines; mechanics of fluids, including turbulence, the boundary layer, heat transfer, and compressible fluids; materials, including elasticity, plasticity, fatigue, and crystal structure; water waves, including resistance and stability of ships and seaplanes. Inquiries regarding the congress should be addressed to the Applied Mechanics division of the American Society of Mechanical Engineers, 29 West 39th street, New York.

Opens Two Offices

Jeffrey Mfg. Co., Columbus, O., recently has opened offices in the Carew Tower building, Cincinnati, and the Rockefeller building, Cleveland. Lyle Martin is in charge of the Cincinnati office and G. D. Francisco and J. R. Warren will represent the company in the Cleveland district.

"Copper" by C. E. Julihn and H. M. Meyer recently has been published in bulletin form by the department of commerce, bureau of mines. The text is from the *Minerals Yearbook* for 1932-33, and may be obtained from the superintendent of documents for 5 cents.

Specializes in Small Castings

(*Concluded from page* 18)

close to the wall and molds are placed on the plates of a pendent conveyor extending from one end of the bay to the other end. Molds are placed on the plates while they are traveling north and they are poured after they have rounded the turn and are traveling toward the south end. Poured molds are dumped over a grating and sand and castings are conveyed to their respective destinations as in the first instance.

The cleaning room is equipped to handle castings either by sandblasting or by tumbling, or if considered necessary, by both methods. Sandblasting units include a rotary table made by the McLeod Co., Cincinnati, and two large, tilting, revolving barrels made by the W. W. Sly, Mfg. Co., Cleveland. Twenty tumbling barrels supplied by the W. W. Sly Mfg. Co., and the Royersford Foundry & Machine Co., Royersford, Pa., are arranged in a double battery, a single battery and in several individual positions. Additions to the original installation have been made on several occasions.

Loaded in Steel Buckets

After they have been cleaned, the larger castings are loaded in steel buckets similar to those shown in Figs. 10 and 11. These buckets are provided with trunnions by which they are suspended from a monorail hoist and conveyed to any desired position on the floor and eventually to the loading dock. A safety catch on the rim above one of the trunnions engages the bail when the bucket is loaded. Upon releasing the catch the bucket rolls over easily since the trunnions are set below the center of gravity.

Small castings from the tumbling barrels drop by gravity through openings in the floor on to a moving belt which carries them upward and discharges them on to a second long horizontal belt. Short, slanting chutes are mounted above and to one side of this belt and a steel bucket for the reception of the castings is spotted in front of each chute. The casting sorters, or inspectors stand in a line on the opposite side of the belt. Each man picks the castings to which he has been assigned, from the miscellaneous collection on the belt, and tosses them into his particular chute. In this manner each bucket is loaded with castings of one classification. An attendant removes the loaded buckets and replaces them with empties as required. Any castings not deflected en route are inspected near the end of the belt where they automatically fall into one of the buckets as shown in Fig. 11.

Castings are shipped by rail or by truck, depending on the volume and destination. A depressed track on the east side of the building brings the floor of the railroad cars on a level with the shipping floor. A similar depression on the south end of the building facilitates loading the trucks.

Castings which require to be ground are placed in the vicinity of 12 double grinder stands supplied by the Sterling Grinding Wheel Co., Tiffin, O. From these stations they are loaded in buckets and taken to the shipping station as in the first instance. All the wheels are uniform in size 2 x 3 x 24 inches.

Small and medium size cores in almost infinite variety are made in the fourth or east bay of the foundry bounded at the south end by the cleaning room and on the north end by that part of the building housing the cupola blower room and another room containing cupola repair material including a stock of silica stone in large slabs and in regular shaped blocks.

Sands in various combinations and bonded with oil or with dry binders are prepared for use in two paddle type mixers. A certain number of miscellaneous cores are made on the bench by hand, but the great bulk of the cores, repetition cores in vast number and variety are made on a battery of five core blowing machines supplied by Wm. Demmler & Bros., Kewanee, Ill. In many instances the cores are turned out on plain flat plates. With others a dryer shell is required to maintain the shape and prevent distortion and sagging during the drying period. The operator removes the corebox from the machine, removes the upper half of the corebox and replaces it with the dryer shell. The assembly then is inverted and the remaining half of the corebox is removed, thus leaving the core exposed and resting in the dryer shell.

Cores are loaded on racks and the racks are placed in either one of two batteries of core ovens, one at the south and one at the north end of the bay. Each battery of ovens is made up of four units. Many of the smaller cores which require only a short baking period, are dried in three shelf ovens located at one side and close to the battery of rack ovens at the north end of the core making bay. All ovens are fired with gas.

This is the second of two articles dealing with the gray iron foundry of the Electric Auto-Lite Co., Fostoria, O. The first appeared in the January issue.
THE EDITORS.

A meeting of the American section of the Society of Chemical Industry devoted to an address by Prof. Donald B. Keyes, University of Illinois, Urbana, Ill., on "Cooperative Studies on Sulphur Dioxide Removal from Flue Gases" will be held Feb. 16 at the Chemists' club, 52 East 42nd street, New York.

Discusses Alloys Before Detroit Founders

W. E. McCullough, chief metallurgist, Bohn Aluminum & Brass Corp., Detroit, addressed the members of the Detroit Foundrymen's association, at a meeting Jan. 18 in the Sovoyard club on "Properties and Fabrication of some Nonferrous Alloys."

The committee also reported on plans for the annual foundry short course to be held at East Lansing under the auspices of Michigan State college.

Book Review

The Principles of Metallurgy, by Donald M. Liddell and Gilbert E. Doan, cloth, 626 pages, 6 x 9 inches, published by the McGraw-Hill Book Co. Inc., New York, and supplied by THE FOUNDRY, Cleveland, for $5.50 plus 15 cents postage, and in Europe by the Penton Publishing Co. Ltd., Caxton House, Westminster, London.

This book has been prepared to fulfill two functions, namely to give the engineering student who does not purpose to take up metallurgy as a life work a general view of the subject, and at the same time to give the student intending to become a metallurgist a proper foundation for his vocation. Because the authors have introduced various practical suggestions, the book undoubtedly will prove valuable to the metallurgist or consultant as a quick reference to basic data.

The work is divided into three parts, as follows: Materials consumed in metallurgy; extractive processes and apparatus; and physical metallurgy. In the section devoted to physical metallurgy, an endeavor has been made to explain the basic nature of metallic substances and their properties in general rather than to describe certain metals and alloys which now are found in common use. The authors believe that in an industrial world where change is continuous, it is more important to develop a way of thinking about metals than to memorize any information, of temporary interest, about individual metals and alloys.

In thawing out pipe lines, the National Safety council recommends that lines be thawed from the ends to relieve any pressure which may be built up. Valves should be opened. If a blow torch is used to thaw out lines the torch never should be left unattended.

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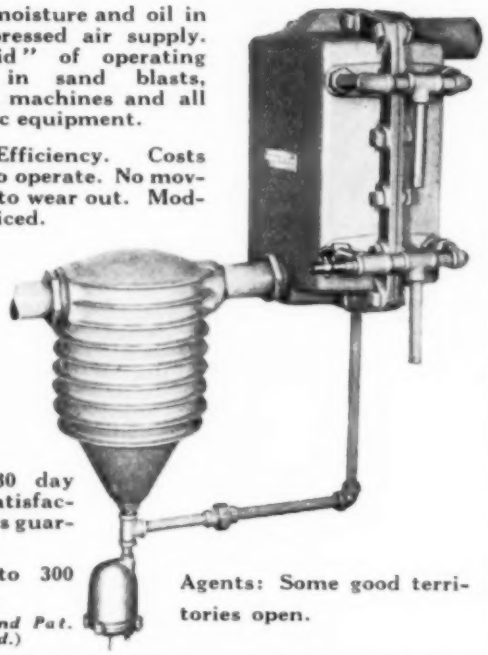

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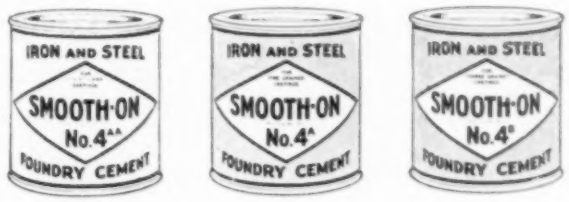

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Galvanizing Malleable Castings

(*Concluded from page 20*)

been galvanizing steel products the extreme solubility of malleable iron in the molten zinc may not be appreciated and to illustrate this the results of a comparative test are illuminating.

In this test strips of metal 5 x 0.75 x 0.25-inches were suspended by wires to a bar which crossed the idle end of a galvanizing kettle in regular operation. The strips were immersed for 3 inches of their length in the zinc and after 72 hours during which a recording pyrometer showed the temperature ranged between 810 and 865 degrees Fahr. the specimens were removed, stripped of their coating and measured.

On the malleable specimens the dross crystals grew out to a great thickness like a moss and finally dropped off when removed from the zinc at the end of the period. The accompanying table shows the results of measurements. From this it may be seen that action on malleable iron is 12½ times as great as on this steel specimen and action on gray iron was only seven times as great.

Defines Several Terms

The piece of steel used for the test was cut from a piece of 2-inch angle iron and was therefore not so resistant to zinc action as the low-carbon fire box steel which generally is used for the side plates of a galvanizing kettle.

The dictionary describes dross as being a scum or refuse matter but this term is not so applied in galvanizing. The burned out flux which has thickened on the surface of the molten zinc when not galvanizing for a few hours is called *salammoniac skimmings* as it retains some salammoniac which must be removed by the refiners or smelters who buy that material.

If the kettle stands idle for a few hours without a covering flux there is an accumulation of dry powdery material on the surface of the molten zinc. This consists of the oxides of zinc, iron, aluminum, etc. with some mechanically entrapped drops of zinc. This also is sold to the smelters and brings a little higher price than the *sal skimmings*. This material is called *zinc ashes* and may contain a large percentage of zinc metal.

The term dross in galvanizing is applied to an alloy of zinc with iron which is considerably heavier than zinc and therefore collects in the bottom of the kettle. The basis of this dross is a chemical compound of zinc and iron expressed by the formula $FeZn_7$, the crystals of which grow upon any piece of iron which is immersed in molten zinc. When the piece of iron is moved about or withdrawn from the zinc some of these crystals are loosened and fall to the bottom of the kettle.

At the end of a week's run the kettle may be found to be half-full of the dross which may be detected by running an iron bar down into the zinc. The bar will meet resistance when it passes into the dross, which feels like fine sand. If too much accumulation is left in the kettle it will be stirred up from the bottom when working and produce a poor coating. It may also pile up against the parts of the kettle where most of the heat transfer from the fuel takes place and cause overheating of the side plates and ultimate failure of the kettle at that point.

Dross is removed from the kettle by a shovel made of heavy steel plate, perforated with holes for drainage of the good zinc and fitted with a handle of heavy pipe which is about 3 feet longer than the kettle and provided with a tee end so it may be pushed into the kettle by several men. This drossing shovel is lifted with its load of dross from the kettle by a hoist and allowed to rest on the edge of the kettle for a few minutes to drain out the free zinc. To speed this drainage the pasty mass is sliced several times with an ordinary spade and the handle is jarred by blows from a heavy sledge hammer.

When drainage is considered complete the pastry dross is taken from the large shovel by the spade and transferred to small iron molds and patted down well to compact the slab so it will not break up too easily in handling. After cooling for a few minutes the slabs in the molds may be quenched with water and dumped out so that the molds may be used again. This slab dross being usually over 95 per cent zinc is valuable to the smelters who buy it at a price ranging from 60 to 80 per cent of the market value of zinc.

A great amount of zinc may be wasted by poor drossing practice and perhaps the largest factor in this is to remove dross when the metal is too cold. Where conditions permit it appears best to do this on the day following operation and to allow the temperature to run up to about 920 degrees Fahr. which allows the dross to settle well and the extra heat in the metal makes the good zinc drain out more freely.

In a case where this custom was disregarded because several hours was required to heat the kettle and the firm desired to economize on labor, the drossing took place at the end of operations on Friday when the temperature was only about 860 degrees Fahr with the result that the dross produced increased about 50 per cent. Dross removed from a kettle at too low a temperature will be quite light colored like the zinc and the iron percentage may run only 2 to 3 per cent whereas drossing at proper temperature will produce dross with iron content of 4 to 4.5 per cent and the color will be light straw to yellow.

If much higher temperatures are resorted to the kettle will suffer undue deterioration and the smelters who buy the dross will object to giving full credit on account of the oxidation as well as the higher iron content.

High temperature dross will appear granular, breaks easily, and will range up to deep blue in color. This is called *dry dross* or burned dross. The composition of this will show about like the three samples which were analyzed with the following results: A—5.1 per cent iron—blue in color; B—5.4 per cent iron—blue in color; C—4.7 per cent iron.

Regalvanizing Increases Dross

Where the inspection is rather rigid for the galvanized finish particularly on small malleable ells which do not easily drain when shaking out the surplus zinc, it frequently is necessary to regalvanize 10 or 15 per cent of these castings and of course this increases the dross production.

The amount of dross produced based on a year's figures for malleable pipe fittings showed 143 pounds per ton of work.

This is the second and concluding article on "Galvanizing Malleable Castings." The first appeared in the January issue. THE EDITORS.

Issues Data on Roller Bearings

Timken Roller Bearing Co., Canton, has issued an extensive loose-leaf publication entitled *Timken Engineering Journal*. This book describes all the various types of bearings and gives complete technical data on ratings, load calculations, speed factors and in fact all necessary data covering bearings for the information of engineers and machine designers.

The book is fully indexed and carries marginal tab listing for ready reference. Information on testing, lubrication and service requirements complete the work.

Harold A. Hallstein, general auditor of the Austin Co., Cleveland, has been made vice president of the company. He will continue as auditor, a position which he has held for 7 years.

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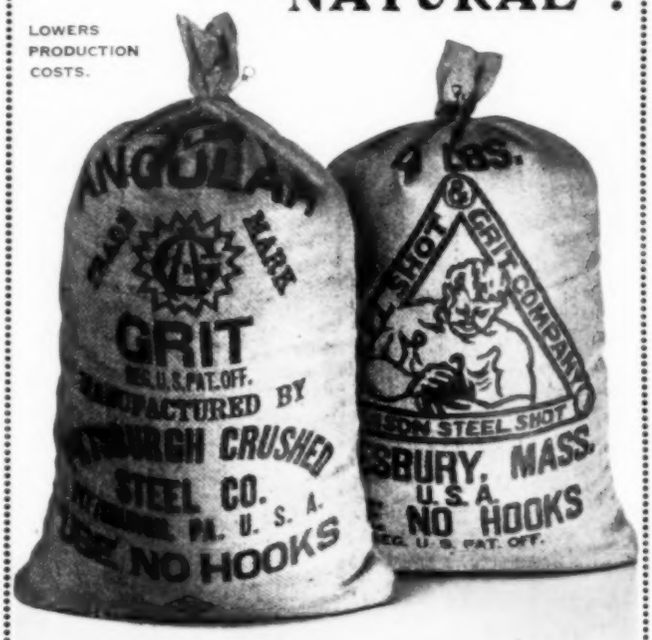

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Die Casting Developments

(*Concluded from page 23*)

to 150 degrees Cent. (302 degrees Fahr.) for about 20 hours develops changes in physical properties as shown in Table III.

This modified silicon-aluminum alloy in the unaged condition is known in Germany as "Silumin Beta" and in the aged condition as "Silumin Gamma." The iron content must be very low. The casting of this and similar aluminum alloys made economically possible by the cold-pressure chamber machine should open new fields for aluminum die castings.

Magnesium alloys may also be cast with the cold-pressure chamber machine. Some castings have been made on such machines, but data on physical properties are not at hand. An alloy of approximately 89.7 per cent magnesium, 10 per cent aluminum and 0.3 per cent manganese (Electron) may be used.

It would be too broad a statement to say that this newer type of machine will replace the old type, but it can easily be said that the introduction of the cold-pressure chamber machine in the United States already has opened the brass field to the die casting industry, and will open new fields for aluminum, magnesium and zinc base alloy die castings in the near future.

Seek New Die Steels

Intense research in new alloys and in die steels for use with brass to increase the economy of this newly developed field is essential and is in progress.

In actual service aluminum die casting dies are subjected to sudden stresses due to local and sudden heating as the molten metal is forced into the die. Die steels fail by developing fine heat checks or large cracks. Failures are accentuated by the presence of small surface imperfections such as scratches and this indicates that the concentration of stresses due to sharp angles or notches must be taken into consideration in comparative studies of die steels. High notched bar impact strength at both room temperature and at the elevated temperatures at which these dies operate would seem to be desirable.

In addition to notched bar impact toughness, a good die steel for aluminum die castings should have a fair degree of resistance to the erosive action of molten aluminum alloys, satisfactory machinability in the annealed condition, should show little movement or distortion upon hardening and should be available at a cost which is not prohibitive.

With these aims in view and as the result of considerable experimental work on steels of various compositions, James P. Gill, metallurgist, Vanadium-Alloys Steel Co., Latrobe, Pa., has developed a new die steel containing approximately 0.30 per cent carbon, 1.00 per cent silicon, 5.00 per cent chromium, 1.00 per cent tungsten, and 1.50 per cent molybdenum. This new steel is a considerable improvement over previous steels available to the die casting industry and makes the production of aluminum die castings a more economical process and, therefore, makes possible a further extension of the field of application of the product.

—Courtesy New Jersey Zinc Co.

Better physical properties of alloys and use of slightly higher pressures have made it possible to reduce wall thicknesses in zinc-base die castings. In automobile horns, such as shown here, a wall thickness of 0.034 inch is not unusual

Book Review

More Power to You, by Walter B. Pitkin, cloth, 292 pages 5 x 7 3/4 inches, published by Simon & Schuster, New York, and supplied by THE FOUNDRY, Cleveland, for $1.75 and in Europe by the Penton Publishing Co. Ltd., Caxton House, Westminster, London.

The author of "Life Begins at Forty" has presented another interesting discussion concerned chiefly with an inspirational subject. Believing that we are not making the most of our lives for the amount of energy expended; that as a nation, because of maladjustments, we produce more nervous breakdowns, neurotics, neurasthenics, frazzled nerves and chronic worriers, the author has prepared a working technique for making the most of human energy.

The book is written for normal people. Through planning of lives and proper training, the author concludes that in the vast majority of cases it is possible for the normal individual to double his or her efficiency. Thus the book discusses the technique of efficiency much more than the creation of new energies, efficiency being defined as the relation between energy spent and results gained.

The individual will find this book an excellent means of self analysis to determine if energies are being expended efficiently, if peak performance is being secured. It is altogether probable that the business executive may apply the principles developed in the solution of problems pertaining to employe efficiency.

Connecticut Association Elects Officers

Connecticut Nonferrous Foundrymen's association elected the following officers at a meeting held Jan. 8 in New Haven, Conn.: President, David Tamor, Reading, Pratt & Cady Co., Hartford, Conn.; vice president, G. F. Winslow, Bradley & Hubbard Mfg. Co., Meriden, Conn.; secretary, Louis G. Tarantino, Niagara Falls Smelting & Refining Corp., 523 West Taft avenue, Bridgeport, Conn., and treasurer, Wesley Case, Belknap Mfg. Co., Bridgeport, Conn.

The executive committee was appointed as follows: Chairman, G. F. Winslow; O. G. Wiley, Jenkins Bros. Co., Bridgeport, Conn.; H. A. Phelps, Phelps Foundry Co., Ansonia, Conn.; Herbert Thompson, Peck Bros. Co., New Haven, Conn.; Benjamin Stewart, Benjamin Stewart & Sons, Mt. Carmel, Conn.

The program committee consists of O. G. Willey, chairman, J. B. Biana, Whipple & Choate Co., Bridgeport, Conn., and Louis G. Tarantino.

Following the installation of officers, V. P. Weaver, technical department, American Brass Co., presented an interesting illustrated lecture on beryllium copper.

Advises on Use of Alloys in the Foundry

H. F. Roberts has been appointed foundry specialist for Williams & Co., Inc., Cleveland, advising on the use of alloys in the foundry field.

J. D. Christian, 514 Brannan street, San Francisco, recently has been licensed by the Falk Corp., Milwaukee, to manufacture a line of motors.

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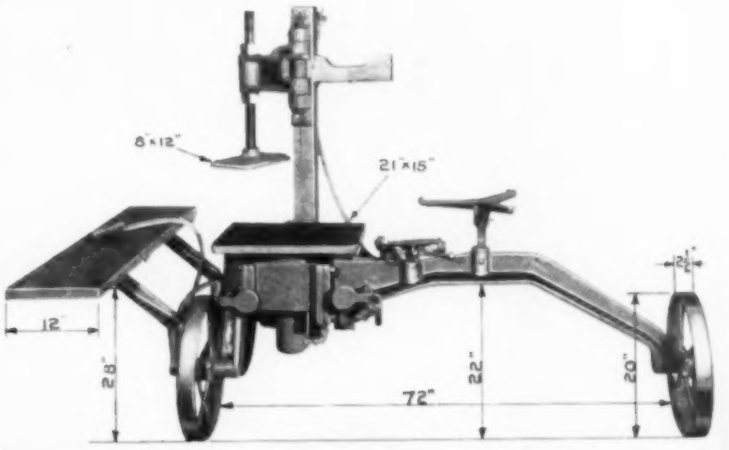

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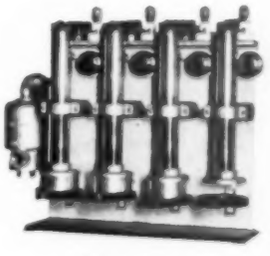

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Die Casting

Generalities on Pressure Die-Casting, (Generalites sur la Fonderie Sous Pression) by A. Brizon. *Bulletin* of Association Technique de Fonderie, Paris, November, 1933.

Die-casting machines can be classified as follows: (1) Method of penetration of the alloy in the die, as piston, compressed air and vacuum machines; (2) Method of operating machine, is by hand, semiautomatic, or completely automatic; (3) Shape of the machine, either vertical or horizontal.

Generally speaking, alloys having lead or tin as a base can be cast in piston machines under low pressure (225 pounds per square inch). Alloys with a zinc base, like those with an aluminum base, are better cast in a compressed air machine under a pressure of from 450 to 600 pounds per square inch. Brass must be cast in a piston machine under high pressure 2250 to 3000 pounds per square inch and more.

The article describes in detail the Buhler casting machine, which is used in the author's works for alloys having zinc as a base. This is a compressed air machine operating under 450 pounds per square inch; it is semiautomatic and horizontal. Dies are made for central injection, and direction of the penetration of metal is perpendicular to the joint. A special electro-magnetic safety device insures a die hermetically closed before metal is injected. Metal temperature is an important factor, and an automatic regulator controls the bath temperature between 410 and 450 degrees Cent. By taking special precautions, it has been possible to limit variations of temperature of the bath to plus or minus 4 degrees for a regulated temperature of 435 degrees.

It is advisable to have duplicate compressors to avoid stoppage due to one machine being out of order. Machines should be run at a speed 15 to 20 per cent below that indicated by the manufacturer. Die-casting brass is more difficult than white metals. Brass die-casting machines generally are the piston type, with horizontal hydraulic press for opening and closing dies. Brass generally is of 60-40 composition melted in a separate furnace. A small furnace is placed close to the machine to maintain correct metal temperature. Metal is poured into the machine with a hand-ladle. Best results are obtained when brass is poured in a pasty condition.

Die plays an important part in the operation of the die-casting process. For alloys with zinc or aluminum as a base, the die counts for 80 per cent in the success of the operation. Casting must be so designed that an adequate die can be made for it. The author outlines a number of principles to be followed in the manufacture of dies, including position of the joint, determination of fixed and mobile portions of the die, point at which the metal should enter the die, orientation of the casting in the die, location of the runner, preparation and placing of cores, water circulation, assembling of the two portions of the die, ejecting devices, safety devices, air vents, machining of dies, and choice of metal used for making dies. It is pointed out that for die-casting brass, the problem of the particular grade of steel necessary for obtaining the best results is not yet satisfactorily solved.

Principal alloys for die-casting are: (1) Alloys with a lead and tin base; (2) Alloys with a zinc base; (3) Alloys with an aluminum base; (4) Copper alloys—(brass in particular); (5) Alloys with magnesium base. White alloys having a lead and tin base generally are as follows: (1) 70 to 80 per cent tin, with 5 to 10 per cent lead, 5 to 10 per cent antimony, and 5 to 10 per cent copper; (2) 86 per cent lead, 12 per cent antimony, and only 2 per cent tin.

A satisfactory zinc alloy is obtained by adding 0.1 per cent magnesium, and castings can be obtained with such alloys with tolerances plus or minus 0.02. In zinc alloys it is necessary to eliminate impurities, particularly lead, tin and cadmium. Under good conditions, only causes of porosity in a casting made of a zinc alloy are injection of metal at a wrong point, or incomplete evacuation of air from the die. Zinc alloys should answer to exact analyses and be poured at a determined temperature.

Alloys with aluminum as a base include the following three descriptions: (a) 92 per cent aluminum; 8 per cent copper. (b) 87 per cent aluminum; 13 per cent silicon (alpax type). (c) About 85 per cent aluminum; 8 per cent silicon; 7 per cent copper. Brass alloys generally are 60 per cent copper and 40 per cent zinc.

Volume Variation

Study of Shrinkage, (Etude du Retrait), by the Scientific Committee of the Association Technique de Fonderie de Belgique. Rapporteur: R. Berger. *La Fonderie Belge*, Liege, October, 1933.

Following a short description of the constitution of cast iron, based on the iron-carbon diagram, and a summary of physical characteristics of pure iron, cementite and graphite, a brief review is given of the investigations made on variations of specific volume of industrial irons by Sauerwald, Zimmerman and Esser, Honda and Endo. The author then studies liquid contraction, and reviews the work of Benedicks and Ericsson, Schwartz, and of the bureau of standards. Variations of volume during solidification are dealt with, and the work of Benedicks and Schwartz is briefly reviewed.

Conclusions of the article are as follows: As regards variation of volume in the liquid state: (a) the specific volume of liquid cast iron decreases with the temperature in accordance with a linear law; (b) at a given temperature, elements that have an atomic weight lower than that of the iron increase the specific volume of the cast iron. The principal elements in this category, in order of importance, are: carbon, silicon, phosphorus, manganese.

As regards variation of volume during solidification, whatever may be the process of crystallization of the iron, there is a sudden, decrease of volume the moment solidification commences. In the case of gray irons, however, expansion due to primary graphitization follows this first contraction.

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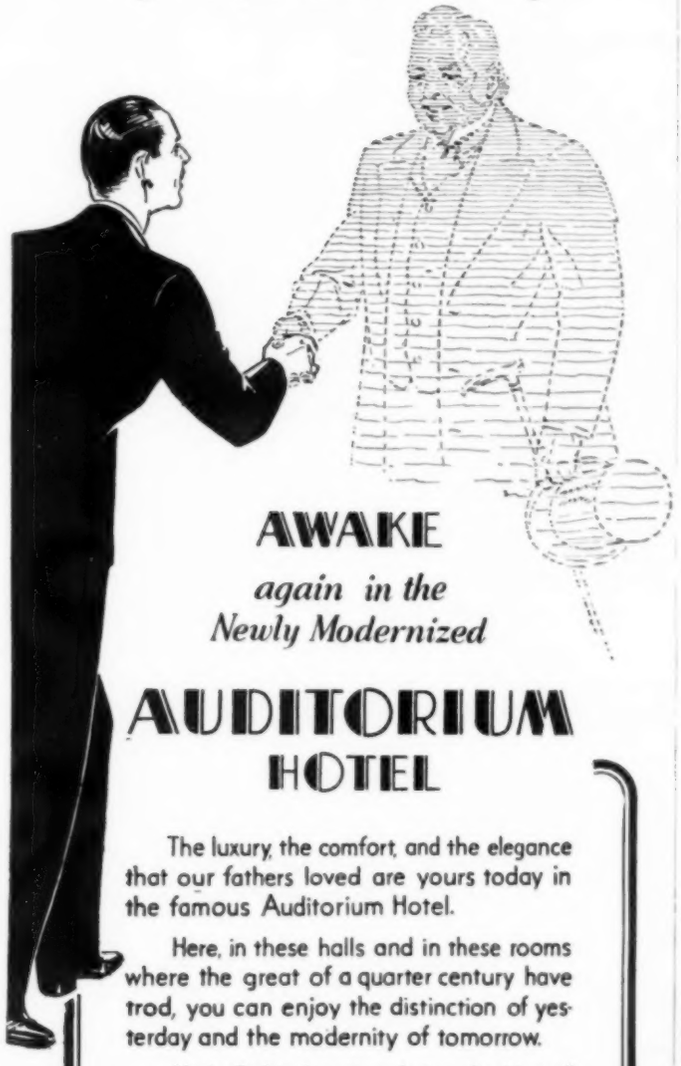

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Obituary

HARRY H. WYATT, 48, secretary-treasurer, Detroit Gray Iron Foundry Co., and vice president, Detroit Alloy Steel Co., died Jan. 28. Mr. Wyatt was born in Warwick, England, and came to America at the age of 3. He received his education in Omaha, Neb., and moved to Detroit in 1906 where he entered the employ of the Parke Davis Co. He remained with that company 5 years until he became associated with the Security Trust Co. as public accountant. In 1918 he joined the Detroit Gray Iron Foundry Co.

George R. Lyon, research engineer, Darling Valve & Mfg. Co., Williamsport, Pa., died recently.

Whitten Duncan, 68, vice president of the Phillips & Buttorff Mfg. Co., Nashville, Tenn., died in Pittsburgh, Jan. 16, while enroute to New York.

James Peachey, 77, one of the founders and partners of the West & Peachey Foundry Co., Simcoe, Ont., died recently at his home.

George C. Ames, former president, American Brake Shoe & Foundry Co., New York, died Jan. 17 at Washington. Mr. Ames retired from the presidency of the American company several years ago and has been a resident of Washington for the past 2 years.

William Torrance, 76, pioneer operator of LaCrosse, Wis., died in Milwaukee, Jan. 21. Mr. Torrance joined his father in 1877 in establishing John Torrance & Son, producer of gray iron castings, and was one of the organizers of the LaCrosse Bridge & Steel Co.

Charles F. Lang, 62, former president of the Lakewood Engineering Co., Lakewood, O., died at his home Jan. 24. Becoming associated with the Lakewood company in 1906, he retired several years ago when that company was consolidated with the Jaeger Machine Co., Columbus and Cleveland.

Joseph S. Oechsle, 39, consulting engineer, Worthington Pump & Machinery Corp., died at the Hahnemann hospital, Philadelphia, recently. Mr. Oechsle was one of the founders and later president of Metalweld Inc., of Philadelphia, before that company was consolidated with the Worthington Co., in 1931.

Wiley J. Dunham, 72, retired president of the Dunham Co., Berea, died recently at Fort Lauderdale, Fla. Mr. Dunham was born in Hinckley, O., and moved with his parents to Berea in 1889, when his father transferred his plant to that city. Wiley Dunham began working in the foundry at the age of 14.

Joseph W. Wilkens, 55, secretary-treasurer, Claffey Casting Co., Waukesha, Wis., died Jan. 11. He was born in Waukesha and was one of the original stockholders of the Waukesha Motor Co. He retired a year ago to establish the Claffey Co. which at the time took over a company in Waukesha.

Seymour W. Doran, 52, for many years personnel director, Pratt & Letchworth Co., Buffalo, died Jan. 13 in his home.

Harry H. Wyatt

Paul Maehler, 69, president of the Paul Maehler Co., Chicago, manufacturer of ovens for foundry and other industrial uses, died Jan. 25 at his home in that city. Mr. Maehler had been engaged in business in Chicago for nearly a half century. His death followed a few hours after that of his wife, Mrs. Anna Maehler, 72.

Thomas G. Stewart, 54, formerly foundry superintendent for the J. I. Case Co., Racine, Wis., died Jan. 30 in Tcheliabinsk, Russian Siberia, just across the Ural mountains. He had gone to Russia in 1931 at the request of the soviet government to take charge of a large tractor plant at Kharkov. Mr. Stewart was born near Galesburg, Ill., in 1879 and first became identified with the J. I. Case Co. in 1918. He left the company for a short time but returned in 1924 as foundry superintendent, which position he held until 1931. In 1933 he was transferred from Kharkov to Tcheliabinsk, Siberia, to supervise the development of a new tractor plant there.

M. G. Spencer, vice president and general manager, Electric Steel Castings Co., Speedway, Indianapolis, Ind., died at his home in that city Jan. 24. Mr. Spencer long was identified with the steel industry, having started his career with the Midvale Steel Co., Philadelphia, with which firm he was connected until 1917. He served in the ordnance department at Watertown Arsenal from 1917 to 1919 when he became connected with the Electric Steel Castings Co. He was a member of the American Society for Steel Treating, American Institute of Mining & Metallurgical Engineers and through his firm, with the Steel Founders' Society of America.

Robert Bernard Tillman, 26, metallurgist, Industrial Steel Casting Co., Toledo, O., and son of the late Joseph L. Tillman, died in St. Vincent's hospital, Toledo, Jan. 24. Mr. Tillman was a graduate of St. John's high school and college and studied metallurgy at Carnegie Institute of Technology, Pittsburgh. He was secretary of the Toledo chapter of the American Society for Metals.

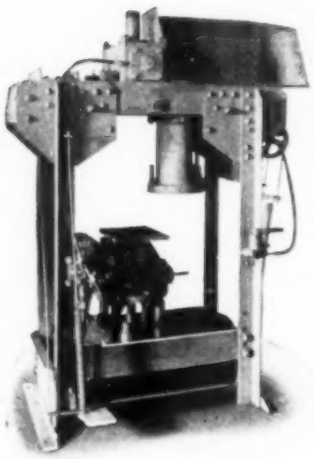
Book Review

Molding Sand and Molding Materials (Die Formsande und Formstoffe), by K. Schiel, paper, 155 pages, 6¼ x 9¼ inches, published by Wilhelm Knapp, Halle (Saale), Germany, and supplied by THE FOUNDRY, Cleveland, and in London by The Penton Publishing Co. Ltd., Caxton House, Westminster, London.

This volume is part 18 of a series relating to works practice of iron, steel and metal foundries which is edited by Hubert Hermanns. The book is divided into two main headings dealing with raw or new sand, and used sand, and each heading is subdivided. The chapter on new sand is subdivided into sections on general characteristics, origin of molding sand, investigation of refractoriness, clay content, grain size, impurities, permeability and binding strength, and classification of molding sand. The second chapter main subdivision headings are still further divided, and cover the following: General characteristics, preparation of the used sand, rules for the application of molding materials, protective and coating materials, investigation of used sand, and works investigation and application of the principles of sand research.

Recloses Breaker

A direct-acting reclosing device for use with oil circuit breakers has been introduced by the General Electric Co., Schenectady, N. Y. The attachment will reclose a breaker one, two, or three consecutive times, with equal time intervals between reclosures, when the breaker is tripped by overload. If the overload disappears after any reclosure, the attachment will return to its normal position and the breaker will remain closed. If the overload still exists after the last reclosure, the breaker will remain locked open and it will be necessary to close it manually before any further automatic operation takes place.



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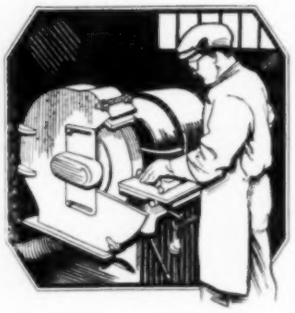
213-S. F. D.

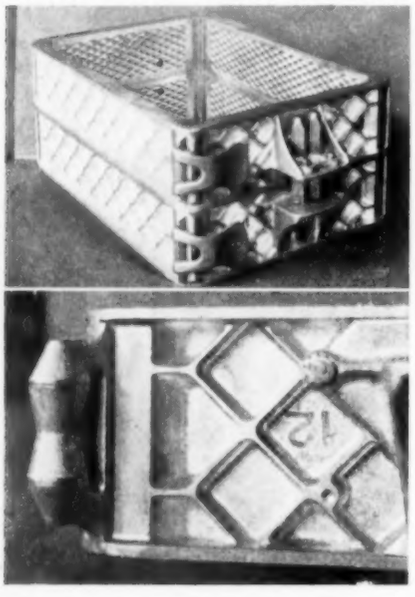
New Equipment



For Foundries

Aluminum Flask Presents New Features

Rigidity, close fit, light weight and practically unlimited life are some of the features claimed for an aluminum snap flask recently placed on the market by the Hines Pattern & Mfg. Co., 10108 Detroit avenue, Cleveland. The flask shown in the



Hinges and catches on the flask are diagonally opposite

accompanying illustration, 12 x 18 inches, 4-inch cope and 4-inch drag weighs 27 pounds. The indented diamond face on the inside eliminates the usual sand strip and provides that much extra room on the inside of the flask.

The joints are ground to a true plane and the flask is assembled around a standard block for uniformity of size and shape. This in turn provides a close fit of bands and slip jackets where a number of the flasks are employed. The flask is provided with monel metal guide pins upon which the pin ears slide easily. The ears are removable and may be replaced by others to fit the guides on any pattern plate. The hinges and catches at diagonally opposite corners are anchored solidly by molten metal to the frame. The hinge is enclosed completely to prevent admission of sand, moisture or dust. By an ingenious cam and toggle arrangement the catch exerts pressure simultaneously against the side and the end of each flask section. The flask is available in all the usual sizes.

Twin Hook Hoist Has Two Drums on Shaft

A twin hook electric hoist for loads that require handling at two points has been developed by Electro Lift Inc., 30 Church street, New York. The hoist may be suspended rigidly, or carried from a trolley running on a monorail track. It is built in capacities of from 500 to 6000 pounds with electrical equipment for direct current, polyphase alternating current or single phase alternating current. The two drums, operating together, are mounted on an extended drum shaft which may be of any length allowing the hooks to be spaced to meet individual requirements.

The hoists have single worm drive with antifriction bearings used throughout. Parts are enclosed and gears and bearings operate in a bath of grease. Either rope control or automatic push button control may be employed.

Process Converts Iron Surface Structure

Gunite Foundries Corp., Rockford, Ill., has developed a process, called Electriding, for converting the surface structure of malleable or gray iron into a hard carbide structure. A feature claimed for the process consists of obtaining the hardness to depths of 1/16 to ⅛-inch without changing or destroying the malleability of the cast iron structure directly underneath the hardened area.

Rockwell hardness 42 to 45 on the C scale and brinell hardnesses ranging from 350 to 375 are said to be obtained. The process is claimed to be inexpensive relatively and can be used with any castings containing temper or graphitic carbon as found in gray iron or malleable iron. Practically a year's service test on railroad brake heads has shown exceptional wearing qualities.

Electric Furnace Has 25-Pound Capacity

Pittsburgh Lectromelt Furnace Corp., 32nd street and Allegheny river, Pittsburgh, has developed a new 25-pound furnace which may be used for a wide range of operations, as melting, refining or alloying irons and steel, melting ferroalloys and nonferrous metals and alloys, for fusion investigations and ore reductions, etc.

Roof and electrodes are arranged for tilting back by lever mechanism

The small arc furnace operates either with direct, indirect or submerged arcs. The furnace usually is operated direct on 110 volts alternating current or with a transformer on 220 or 440 or even a higher voltage. The roof and electrode ovens are arranged for tilting back by a lever mechanism to facilitate quick and convenient charging. A view of the furnace with the ladle unlined but with the roof and superstructure tilted back part way is shown in the illustration.

The ladle bowl containing the molten bath may be emptied by pouring forward in the stand or by removing the ladle bowl by inserting suitable shank handles in the trunnion parts and carrying the bowl to the place where the metal is to be poured. Pouring shanks are secured to the trunnions when pouring by pins.

A. G. Pratt, president, Babcock & Wilcox Co., recently was elected to the board of directors of the Worthington Pump and Machinery Corp.

Rollers Held in Place by Spacer Bars

A roller bearing for industrial applications, developed by the Fafnir Bearing Co., New Britain, Conn., consists of the conventional inner and outer rings and roller cage assembly. High grade alloy steel is used to give a high fatigue value. The cage is fabricated from specially form-rolled spacer bar stock with carburized and hardened end rings. Additional capacity is gained by increasing the roll length and by using two rolls of rollers where necessary.

In the cage construction the rollers are held in place by spacer bars which are riveted to the end rings. The accurate assembly of the bars is designed to keep the rolls permanently aligned. The entire roller bearing assembly is made with a fixed radial clearance to allow for the expansion which takes place when the inner ring is shrunk to the shaft. The clearance also permits the bearing to operate when temperature differentials occur in operation.

The pillow block bearing is supplied with bolted-on end covers to permit easy assembly and disassembly.

Bench Furnace Has Variety of Purposes

Red Devil Mfg. Co., Bellwood, Ill., recently has introduced a three burner, gas bench furnace designed for use in heating soldering irons, hatchet irons, branding irons, for heat treating carbon steel tools and other metal parts, and for melting small quantities of babbitt, lead, tin, zinc and other soft metal.

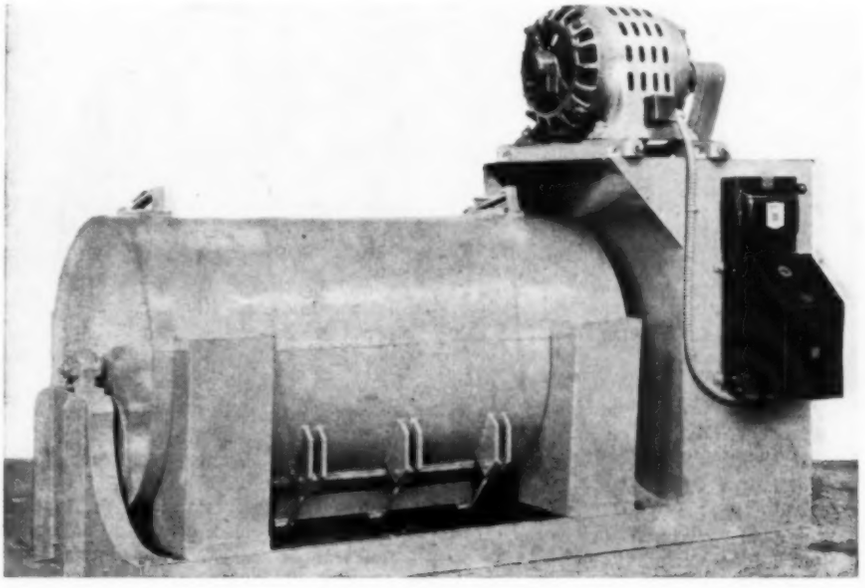
The furnace has three bunsen burners, each with a shut-off valve. The firebox is lined throughout with fire clay. The unit is equipped with a pilot light so that the gas is lighted automatically when the burner is turned on. It is claimed that a firebox temperature of 1800 degrees Fahr. is obtained without a blower.

Handles Tumbling Stars Mechanically

A method of tumbling castings which eliminates manual handling of stars and other tumbling material has been introduced by N. Ransohoff, Inc., Cincinnati. The process makes use of a side-loading barrel with a central tumbling section and two end sections for receiving the separated stars. Passages of special design transfer stars automatically to the central section when the drum is rotated in the tumbling direction and return them to the end sections when the drum is rotated in the opposite direction.

The work especially when it consists of large or fragile pieces, may be packed to the full capacity of the tumbling section in much the same manner as an old style barrel is loaded. Rotating the barrel in the tumbling direction conducts all of the stars into the central tumbling section where they distribute themselves thoroughly through the work. Due to the weight of the large quantity of stars used, the cleaning operation is said to proceed rapidly and thoroughly. Reversal of the drum automatically returns the stars to the two end sections and the finished work is removed through the side port.

The new barrel is claimed to be excellent for wet, as well as dry tumbling. In wet tumbling, hollow trunnions allow the entry of a water spray which is used to rinse the finished work just before its removal and for washing the stars in their compartments, screen patches being provided for draining the star sections. When used for dry tumbling, the hollow trunnions are fitted for connection with an exhaust system for dust removal.



The process makes use of a side-loading barrel with a central tumbling section and two end sections

Optical Pyrometer Is Self-Contained Unit

Pyrometer Instrument Co., 103 Lafayette street, New York, recently introduced an optical pyrometer shown in the accompanying illustration, incorporating three separate direct reading scales. One reads from 1400 to

The optical pyrometer has three separate direct reading scales

2000 degrees Fahr.; a second scale reads from 1800 to 3400 degrees Fahr.; and a third red scale ranges from 2200 to 3600 degrees Fahr. corrected for direct reading of true spout and pouring temperatures of molten iron and steel when measured in the open. The instrument is self-contained and is claimed to be dust proof. A master lamp for each checking is furnished with the device.

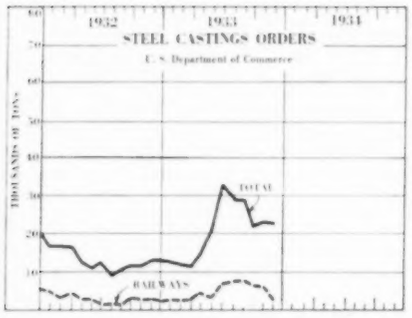
Develops New Resin

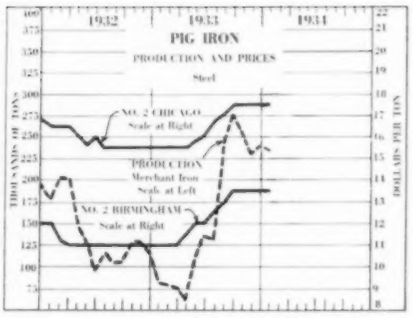
A new resin, which is said to be hard, black, tough, nontacky, and oil-resistant, recently has been introduced by the Hercules Powder Co., Wilmington, Del. The material has been developed for use in insulating varnishes, impregnating compositions, lacquers, emulsion paints and thermoplastics.

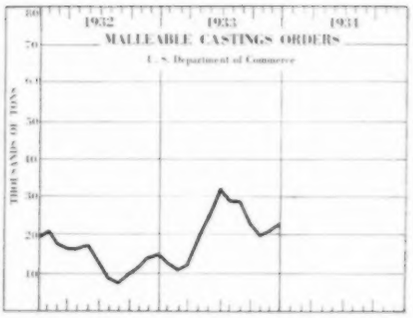
Introduces Flux

A new all purpose aluminum welding flux recently has been introduced by the Linde Air Products Co., 30 East 42nd street, New York. The new flux is intended to replace two fluxes previously marketed, one for welding pure aluminum and the other for welding aluminum alloys.

The bureau of mines recently has published *Mineral Resources of the United States* 1930. Part I, dealing with metals, contains 1142 pages and gives detailed statistical data on all mineral products according to state or regional reports. The volume may be purchased through the superintendent of documents, Washington, for $1.50.







Foundry Activities

Reflect Industrial Trends

FOUNDRY operations in the Chicago district recorded fairly good gains in January, due chiefly to the demands of the automotive industry and increased schedules of farm equipment manufacturers. A slight increase has been recorded in the production of machine tool castings.

* * *

Continental Die Casting Corp., Detroit, has moved to larger quarters at 2950 Woodbridge street.

* * *

Hub City Iron Co., Aberdeen, S. Dak., has been incorporated with $100,000 capital by Ansel T. Green and Robert J. Fritsche.

* * *

Madison Foundry Co., 1488 Madison avenue, Detroit, recently has been incorporated by Howard H. Newman.

* * *

Walton East Branch Foundry Corp., Walton, N. Y., has been organized by Francis S. Clarke and Charles L. Walsh.

* * *

Plant of the Massey-Harris Co., Batavia, N. Y., resumed production recently after an idleness of 2 years. Henry G. Trelawney is superintendent.

* * *

W. C. Snyder has moved his aluminum foundry from Bryan, O., to Montpelier, O., where he will produce aluminum, brass and bronze castings.

* * *

Production and shipment of steel castings by foundries operating in the Philadelphia Federal Reserve district increased during December according to reports of the Industrial Research department, University of Pennsylvania. On the other hand the tonnage of malleable and gray iron castings produced during December declined.

* * *

Iron Products Co., Baroda, Mich., recently moved to a new location in the Schultz building. The company was formed a year ago by Charles Hapke and Alex Kamber.

* * *

Assets of the Western Iron & Foundry Co., Wichita, Kan., sold recently at receiver's sale, have been acquired by J. Q. Warren, an official of the company and D. A. Swenson, formerly with the Swenson-Headlee Engineering Co., who plan to reorganize the concern. The plant has been in continuous operation under the receivership producing oilfield equipment.

* * *

American Machine & Foundry Co., New York, manufacturer of tobacco machinery, has increased its products to include lithographing, baking, wrapping, weighing and other types of equipment.

* * *

Barnes Inc., Mansfield, O., has been organized to purchase the assets of the Barnes Mfg. Co., which has been in receivership. The company manufactures pumps and sanitary enamelware.

* * *

Galva Furnace & Foundry Co., Galva, Ill., has been organized and a fund raised to start operation. A local foundry plant is to be utilized. F. E. Garnett and Dr. Robert Stewart are interested in the project.

* * *

McQuay-Norris Co., Connersville, Ind., has purchased the east building of the Connersville Furniture Co. and will use it for the manufacture of automobile replacement parts, piston rings, pistons, pumps and bushings.

* * *

Superior Engine Co., Springfield, O., has changed its name to the National-Superior Co. after 45 years under the former style. The change is for corporate reasons, with no change in management of products.

* * *

Paper & Textile Machinery Co., Sandusky, O., has changed its name to the Sandusky Foundry & Machine Co., the style under which it began business in 1904. The change was made to more accurately suggest the nature of the company's products and facilities.

RAW MATERIAL PRICES
Feb. 6, 1934

Iron	
No. 2 foundry, Valley	$17.50
No. 2 Southern, Birmingham	13.50
No. 2 foundry, Chicago	17.50
No. 2 foundry, Buffalo	17.50
Basic, Buffalo	16.50
Basic, Valley	17.00
Malleable, Chicago	17.50
Malleable, Buffalo	18.00
Coke	
Connellsville beehive coke premium	$5.00
Wise county beehive coke	3.50 to 4.25
Detroit by-product coke	8.00
Scrap	
Heavy melting steel, Valley	$13.00 to 13.50
Heavy melting steel, Pitts	$13.25 to 13.75
Heavy melting steel, Chicago	10.50 to 11.00
Stove plate, Buffalo	9.00 to 10.00
Stove plate, Chicago	7.50 to 8.00
No. 1 cast, New York	8.50 to 9.00
No. 1 cast, Chicago	9.00 to 10.00
No. 1 cast, Pittsburgh	12.50 to 13.00
No. 1 cast, Philadelphia	11.50 to 12.50
No. 1 cast, Birmingham	9.00 to 10.00
Car wheels, iron, Pittsburgh	11.50 to 12.00
Car wheels, iron, Chicago	10.50 to 11.00
Railroad malleable, Chicago	11.50 to 12.00
Malleable, Buffalo	11.00 to 11.50
Nonferrous Metals	**Cents per pound**
Casting copper, refinery	7.75
Straits tin	51.12½
Aluminum, No. 12, producers	19.00 to 22.00
Aluminum, No. 12 remelt Cleveland	14.25 to 14.75
Lead, New York	4.00
Antimony, New York	7.15
Nickel, electro	35.00
Zinc, East St. Louis, Ill.	4.40

New Trade Publications

CONVEYORS—Mathews Conveyor Co., Ellwood City, Pa., recently published a well illustrated booklet on its line of conveyers for the steel and metalworking industries. Typical installations provide an interesting picture of the wide variety of conveyer equipment now available. Detailed information is given on the construction of the various types of rollers, wheel conveyers and ball transfers.

TEMPERATURE CONTROL — Bausch & Lomb Optical Co., Rochester, N. Y., has published a bulletin on its constant temperature control equipment for use in the chemical laboratory.

CASTINGS—Spring City Foundry Co., Waukesha, Wis., has issued a bulletin entitled "Pattern at 3 P.M., Castings at 8 A.M." The publication features the equipment of the plant which permits quick delivery of rush orders.

HEATERS—General Electric Co., Schenectady, N. Y., has published a booklet entitled "Spots of Heat for Industrial Plants" in which it illustrates through drawings various applications for its line of spot, strip and dip heating units.

REFRACTORY BOND—A plastic refractory bond for fireclay brick is discussed in a folder recently issued by the Harbison-Walker Refractories Co., Pittsburgh. It is claimed that this material gives a true bond at low temperatures and resists fusion up to and above 3000 degrees.

HOISTS—Construction of its line of electric hoists for a wide variety of industrial uses is described and illustrated in a recent bulletin of the Harnischfeger Corp., Milwaukee. Important features of design are stressed and the ratings and operating ranges of the hoists are included.

VIBRATING SCREENS—Jeffrey-Traylor division, Jeffrey Mfg. Co., Columbus, O., has issued four bulletins devoted to the following subjects: vibrating screens, vibrating conveyors, vibrating feeders, and vibrating coolers-dryers. The various units are electrically operated.

FRICTION MATERIALS—Johns-Manville, 22 East Fortieth street, New York, has issued a bulletin on industrial friction materials, types and their selections. The text includes information on linings, clutch facings and other friction materials. Recommended charts are included.

FLASKS — American Foundry Equipment Co., Mishawaka, Ind., has issued two bulletins, one devoted to its line of cast magnesium alloy taper flasks, and the other to self-adjusting cast aluminum or cast iron jackets. The jacket is designed to adjust itself to a mold from straight side up to a 6-degree taper.

AIR PREHEATERS—Air Preheater Corp., 60 East Forty-second street, New York, under the management of the Superheater Co., has issued bulletin No. 933 on its air preheaters for public utility and industrial steam power plants and for the recovery of industrial heat. Numerous applications are shown.

COMPRESSORS—Single horizontal, single stage compressors, either steam or motor driven, are described in a bulletin of the Worthington Pump & Machinery Corp., Harrison, N. J. Information includes a discussion of the design of various parts of the compressor, and a table of sizes covered by the specifications.

UNIFORM COSTS—Policyholders Service bureau, Metropolitan Life Insurance Co., 1 Madison avenue, New York, has published a booklet entitled "Uniform Cost Activities in Trade and Industry." The material presented is the result of a review of the uniform cost experiences of more than 76 trade associations, including as well the opinions and ideas of a number of responsible executives in a wide variety of industries. Procedures entailed in administering uniform cost activities and methods of preparing uniform cost accounting manuals are discussed.

MOTOR BASES—Rockwood Mfg. Co., Indianapolis, has issued two bulletins one dealing with bases for small motors and the other with standard drive bases. Information is presented on the construction of the base, which is designed so that the weight of the motor automatically maintains constant belt tension. Drawings illustrate the application of the base for floor, walls or ceiling drives.

CLEANING EQUIPMENT—A bulletin devoted to industrial machinery for tumbling, separating, cleaning, washing, burnishing, plating and pickling of metal parts has been published by N. Ransohoff Inc., West Seventy-first street at Milcreek, Carthage, Cincinnati. A side-loading, star-separating tumbling barrel recently introduced ,also is described and illustrated. A number of plants using equipment made by that company are listed.

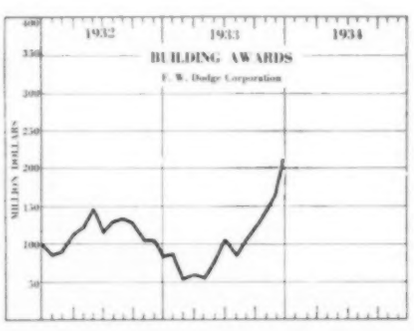
CORE BAKING—Equipment for vaporizing oil for burning in core ovens is described in a recent folder of the Vapofier Corp., 2807 south Michigan avenue, Chicago. Publication indicates a number of foundries using that type of equipment, a comparison of the cost of using city gas, and oil vaporized by the equipment under discussion, and photographs of installations. The equipment also may be used for die casting, galvanizing, steel heat treating, japanning and enameling.

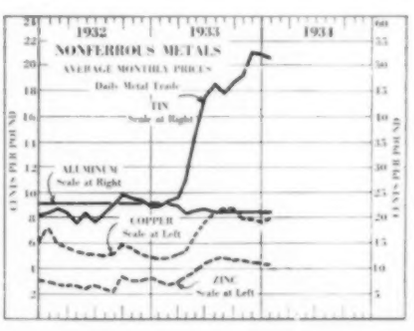
HARD FACING—A 96-page booklet entitled "Hard-Facing with Haynes-Stellite Products" recently has been issued by the Haynes-Stellite Co., Kokomo, Ind. A detailed description is given of various hard facing materials and correct procedure for application by both oxy-acetylene and electric arc processes. Other information includes a description of jigs and fixtures, a list of ferrous and nonferrous metals and alloys showing what materials can or cannot be hard-faced.

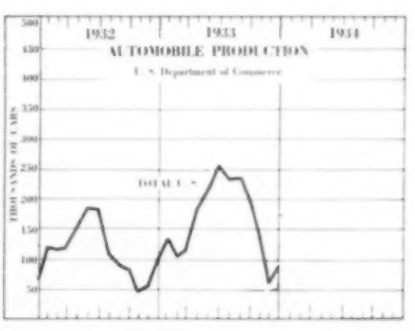
ELECTRIC FURNACES—Special furnaces for the production of ferroalloys, calcium carbide, annealing, ore smelting, etc., are described and illustrated in a recent bulletin of the Pittsburgh Lectromelt Furnace Corp., foot of Thirty-scenod street, Pittsburgh. A second bulletin of that company describes rapid melting furnaces of moderate size for melting and refining various plain and alloyed irons and steels, nickel compositions, and for special work where suitable electric power is available.

Faked Foundry Facts

Bed Charge







Classified Ads

Help Wanted

ELECTRIC FURNACE MELTER WANTED for Eastern Steel Foundry. State full experience and wages desired. Address Box 851, THE FOUNDRY, Cleveland.

CORE OIL SALESMEN WANTED

Exclusive territories open in all parts of the country with America's fastest growing core oil manufacturer. Men who know territory preferred—must know how to sell and demonstrate core oil. Write fully and state if salary, commission or both desired.

CERTIFIED CORE OIL & MFG. COMPANY,
1104 S. Cicero Ave., Chicago, Ill.

WANTED

Representative in Tennessee and Georgia to sell Chaplets and Stove Specialties on commission. Give experience and references in first letter. Address Box 821, THE FOUNDRY, Cleveland.

DEMONSTRATING REPRESENTATIVE

with molding experience wanted in every foundry district, for a proven effective molding commodity with perpetual reorders. Guaranteed working territory given. Strictly commission basis. Good chance to establish a permanent business in your home district. State experience fully. Address Box 816, THE FOUNDRY, Cleveland.

CORE OIL AGENTS

Wanted for eastern Pennsylvania, New York, New Jersey, Tennessee, Alabama, Georgia, and California. Must know how to sell and demonstrate core oil—preference given to those with a following. State territory and full particulars.

CERTIFIED CORE OIL & MFG. COMPANY
1104 S. Cicero Ave., Chicago, Ill.

Employment Service

ATTENTION FOUNDRY OWNERS

Write or wire us for technically-trained practical foundry foremen, superintendent, production managers, chemists, metallurgists, core foremen, cost clerks, salesmen, patternmakers, melters (electric, open-hearth, converter and cupola.) No charge. Licensed Agency. McLAIN'S SYSTEM, INC., 804 Goldsmith Bldg., Milwaukee, Wis.

SALARIED POSITIONS.

$2,500 to $25,000

This thoroughly organized advertising service of 24 years' recognized standing and reputation carries on preliminary negotiations for positions of the caliber indicated, through a procedure individualized to each client's personal requirements. Several weeks are required to negotiate and each individual must finance the moderate cost of his own campaign. Retaining fee protected by a refund provision as stipulated in our agreement. Identity is covered and, if employed, present position protected. If you have actually earned over $2,500, send only name and address for details.

R. W. BIXBY, INC.
101 Delward Bldg., Buffalo, N. Y.

Positions Wanted

POSITION WANTED AS BRASS FOUNDRYman. Experienced on jobbing specialty production and plumber's brass goods. Good metal mixer on high grade work. Address Box 819. THE FOUNDRY, Cleveland.

Positions Wanted

PRACTICAL FOUNDRYMAN

on light jobbing and production work looking for position as foreman or would consider half interest in small gray iron foundry with man capable of bringing in work. East preferred. Address Box 753, THE FOUNDRY, Cleveland.

DO YOU WANT GOOD CORES?

Coreroom foreman thoroughly experienced in light and heavy work. Can install systematic, smooth working core production. Exceptionally successful in handling men. Available immediately. Age 45. Address Box 835, THE FOUNDRY, Cleveland.

GRAY IRON FOREMAN

or superintendent on work from 1 lb. to 50 tons. Specialized heavy machine castings. Mix by analysis. Many years experience as molder foreman and superintendent. Address Box 567. THE FOUNDRY, Cleveland.

SUPERINTENDENT OR FOREMAN

PRACTICAL IN BOTH IRON AND ELECTRIC STEEL. FOUNDRY PRACTICE. AGGRESSIVE LEADERSHIP GUARANTEE. CAPABLE OF MAINTAINING QUALITY CASTING AT MINIMUM COST UNDER ANY CONDITIONS. ADDRESS BOX 800, THE FOUNDRY, CLEVELAND.

BRASS—BRONZE—ALUMINUM

Foreman thorough experience all nonferrous castings, light and heavy, jobbing or production Can take charge mixing, melting, coremaking and molding. Address Box 818, THE FOUNDRY, Cleveland.

FOUNDRY SUPERINTENDENT OR FOREMAN

looking for new connections. 18 years executive Experience on gray iron and nonferrous light or heavy work. At present employed. Go anywhere. Address Box 784, THE FOUNDRY Cleveland.

GRAY IRON FOREMAN OR SUPERINTENDent 29 years experience as molder, coremaker and foreman on jobbing and machinery. McLain graduate. Will take position as working foreman. Excellent references. Address Box 841, THE FOUNDRY, Cleveland.

EMPLOYERS PLEASE NOTE!

When you are in need of a reliable man for immediate or future need, scan the position wanted ads in this section and reply to them. These advertisers will welcome the opportunity to set forth their qualifications.

If the man you want isn't listed here, a Help Wanted ad will bring quick results.

CLASSIFIED RATES

Position Wanted advertisements; minimum ad 30 words, $1.50, additional words 5c each.

Help Wanted advertisements; minimum ad, 50 words $3.00; additional words 6c each.

For Sale, Wanted and Miscellaneous advertisements 10c per word, minimum advertisement $3.00.

Reduced rates for three or more insertions.

First line is set in bold face type. A box address counts as six words.

Positions Wanted

METALLURGIST—ASSISTANT TO SUPERintendent. Graduate mechanical engineer. General foundry experience. Thoroughly versed in both cupola and electric furnace melting of plain and alloy cast iron. Sand control. Age 32. Address Box 848, THE FOUNDRY, Cleveland.

CHEMIST-METALLURGIST

Cupola expert. Knowledge electric furnace. Widely experienced on gray iron, semi-steel, nickel chrome. Automobile, Pipe and jobbing work. Sand control, molding. Address Box 657, THE FOUNDRY, Cleveland.

WOOD AND METAL PATTERNMAKER

Twenty years practical and varied experience, thorough knowledge of foundry practice and production methods. Past ten years foreman, willing to go anywhere, age 38. Married. Very best references furnished. Address Box 832, THE FOUNDRY, Cleveland.

GRAY IRON FOUNDRY SUPERINTENDENT

One of the Mid-West's outstanding foundrymen with unusual ability to effect production economies. Technical knowledge and mechanical skill combined with natural executive ability; aggressive, good organizer. Age 43. Thoroughly competent to handle entire operations, estimating, production, and metallurgical. 15 years successful record as foundry executive with two large companies. Address Box 786, THE FOUNDRY, Cleveland.

ANNEALING AND FINISHING EXPERT. 12 years experience charge of annealing department. Can anneal with powdered coal, oil and hand fired oven. All types of castings. Know manufacture malleable iron. Age 35. Married. Best references. Address Box 725, THE FOUNDRY, Cleveland.

PRACTICAL STEEL FOUNDRY FOREMAN experienced all classes of work, heavy, light, green and dry. Machine or floor, electric or open hearth. Best of references. Address Box 872, THE FOUNDRY, Cleveland.

WILL INVEST ABOUT $10,000 IN SMALL going foundry and machine shop. Wish active part in management having had years' experience buying, selling and general office management, both in foreign and domestic departments. Prefer association with practical shop men. References exchanged. Please write in detail. Address Box 839, THE FOUNDRY, Cleveland.

POSITION DESIRED AS GRAY IRON FOUNDry chemist and metallurgist, or as analytical chemist with a concern handling ferrous alloys and metallurgical materials. Best of reference. Address Box 845, THE FOUNDRY, Cleveland.

GENERAL MANAGER

with splendid record in managing and building up foundry, machinery and allied industries desires position requiring reliable qualifications and dependable service. Ability to economically and efficiently handle all office, sales, financial and production activities unquestionably established by previous experience. Address Box 814, FOUNDRY, Cleveland.

GRAY IRON FOUNDRY SUPERINTENDENT with proven ability, mechanical skill and technical knowledge. Twenty-five years practical experience every department in foundry. Fifteen years executive. Record as excellent organizer, handling all classes of help successfully. Maximum production at minimum cost. Married. Age forty-three. Best references. Address Box 823, THE FOUNDRY, Cleveland.

GRAY IRON AND SEMI-STEEL SUPERINTENDENT OR FOREMAN OPEN FOR ENGAGEMENT. BROAD EXPERIENCE. SMALL AND MEDIUM HEAVY CASTINGS. CAPABLE IN RIGGING AND PATTERN EQUIPMENT FOR MAXIMUM PRODUCTION. AGGRESSIVE LEADERSHIP. MIX BY ANALYSIS. ADDRESS BOX 452, THE FOUNDRY. CLEVELAND.